Society Transactions

EDITED BY DR. JOHN HERBERT WAITE

EIGHTY-SIXTH ANNUAL SESSION OF THE AMERICAN MEDICAL ASSOCIATION, SECTION ON OPHTHALMOLOGY

Atlantic City, N. J., June 10-14, 1935

ARTHUR J. BEDELL, M.D., *Chairman*

PARKER HEATH, M.D., *Secretary*

PAPILLEDEMA AND OPTIC NEURITIS: A RETROSPECT. MR. LESLIE PATON, London, England.

This paper was published in full in the January 1936 issue of the ARCHIVES, page 1.

INFLAMMATORY EXOPHTHALMOS IN CATARRHAL DISORDERS OF THE ACCESSORY SINUSES. DR. MARTIN COHEN, New York.

This paper was published in full in the March 1936 issue of the ARCHIVES, page 457.

ASSOCIATION OF ECTOPIA LENTIS WITH ARACHNODACTYLY. DR. FRANK E. BURCH, St. Paul.

This paper was published in full in the April 1936 issue of the ARCHIVES, page 645.

DIAGNOSIS AND TREATMENT OF ANISOPHORIA. DR. JONAS S. FRIEDENWALD, Baltimore.

This paper was published in full in the February 1936 issue of the ARCHIVES, page 283.

CAUSES OF BLINDNESS IN CHILDREN: THEIR RELATION TO PREVENTIVE OPHTHALMOLOGY. DR. CONRAD BERENS; C. E. KERBY, B.A., and F. C. MCKAY, B.A., New York.

This paper was published in full in *The Journal of the American Medical Association* (**105:** 1949 [Dec. 14] 1935).

THE PUPILLARY REACTIONS IN COMBINED LESIONS OF THE POSTERIOR COMMISSURE AND OF THE PUPILLODILATOR TRACTS: A CONTRIBUTION ON THE PATHOGENESIS OF THE ARGYLL ROBERTSON PUPIL. DR. NORMAN P. SCALA, Washington, D. C., and DR. ERNEST A. SPIEGEL, Philadelphia.

This paper was published in full in the February 1936 issue of the ARCHIVES, page 195.

KINETIC STEREOSCOPY OR STEREOSCOPIC PHENOMENA OF A MOVING OBSERVER. DR. ALEXANDER E. MACDONALD, Toronto, Canada.

Normal phenomena associated with the vision of the moving observer are referred to. The paper deals with muscle imbalance and certain parallactic impressions resulting from this condition, especially from the point of view of operators of moving vehicles.

DISCUSSION

DR. FREDERICK H. VERHOEFF, Boston: Dr. MacDonald offers an explanation of the apparent change in position of a patterned surface that occurs when there is incorrect fixation of the patterns. By incorrect fixation I mean the central fixation of one pattern with one eye and of another but similar pattern with the other eye. This problem is essentially the same as that regarding the changes in apparent position and size of an object produced by converging or diverging prisms. Thirty-three years ago I discussed this problem, to which Duane had previously called attention, and submitted an explanation that, so far as I know, has never been controverted. Dr. MacDonald's explanation that such apparent change in position is entirely due to parallactic movement I believe to be fallacious, because the change occurs when the observer and the object are both stationary. He evidently failed to observe that under certain conditions involving the use of a point or plane of reference the apparent change in position of a patterned surface seen with incorrect fixation may be opposite to that described by him, and that then the parallactic movement to be elicited remains unchanged. As he points out, the relation of accommodation to the micropsia and macropsia associated with vergence is extremely complex. It has, however, little if any relation to his immediate problem, since objects on the ground seen from an airplane even in landing are too remote for changes in accommodation to come into play.

Every one will agree without reading this paper that landing fields should have definite markings, decided on by practical tests, but since one's judgment of relative distance is more accurate than that of absolute distance and more important, I suggest, in addition, that the airplane should have at least one mark, if only a rod, situated as far forward as practical, to be used for reference with respect to the landing field.

DR. ALFRED COWAN, Philadelphia: Good visual acuity is an extremely important factor in judging distance. Barbara Deyo (*Am. J. Ophth.* **5:** 343, 1922) found among one hundred subjects an average minimum displacement of 12.02 mm. for both eyes in a group with visual acuity of 20/15, and a minimum displacement of 28.11 mm. in a group with vision of 20/20.

In myopia with overcorrection, the tendency to accommodate will result in micropsia, as stated here by Dr. MacDonald. The same effect will result in uncorrected hyperopia, but not to the same extent as in overcorrected myopia. Candidates with any except the smallest refractive errors should be disqualified even though they have normal vision. Corrective lenses should not be worn. The aberrations in the eccentric parts of an ophthalmic lens are too likely to interfere with good judgment of distance.

The effect of accommodation on stereoscopic vision at a considerable distance is of no consequence. The whole power of accommodation between 2 meters and infinity amounts to less than 0.5 diopter. As a matter of fact, the only factor of any moment in the judgment of distances greater than from 500 to 600 meters is motion parallax, and in this instance the experienced one-eyed pilot may do better than a less experienced two-eyed pilot. For this reason, the moving observer has a distinct advantage and is better able to judge of great distances than the static observer.

THE VIRUS OF INCLUSION CONJUNCTIVITIS: FURTHER OBSERVATIONS. DR. PHILLIPS THYGESON and DR. WILLIAM F. MENGERT, Iowa City.

This paper was published in full in the March 1936 issue of the ARCHIVES, page 377.

ALLERGY AND CATARACTS. DR. RUBY K. DANIEL, Rochester, Minn.

This paper was published in full in *The Journal of the American Medical Association* (**105:** 481 [Aug. 17] 1935).

CONTROL OF MYOPIA. DR. EDWARD JACKSON, Denver.

This paper was published in *The Journal of the American Medical Association* (**105:** 1412 [Nov. 2] 1935).

HERPES OPHTHALMICUS: I. RADIOTHERAPY IN HERPES ZOSTER OPHTHALMICUS AND HERPETIC KERATITIS. DR. FRANÇOIS BADEAUX, Montreal, Canada.

Attention is drawn to the excellent results obtained with x-rays in the treatment of herpes zoster and herpetic keratitis. The various treatments previously recommended for these conditions are briefly reviewed, and then the dosage and the dangers in roentgen therapy are dealt with. A series of case reports is presented.

DISCUSSION

DR. EUGENE P. PENDERGRASS, Philadelphia: There is an abundant amount of data on the effect of radiation (roentgen rays and radium) on the various structures of the orbit in the experimental animal, but very little on that in the human being. Whether one is justified in translating observations made on the animal to man is open to question. My experience with irradiation around the eyes has given me a healthy respect for several structures, i. e., the lens, the blood vessels (conjunctival, choroid and ciliary) and the eyelashes. Small doses of radiation infrequently repeated will cause cataract to form. Cataracts may require as long as seven years to become evident. Therefore, one cannot feel assured that irradiation will not produce harmful results, even in the absence of a mild reaction following treatment. Blood vessels are susceptible to radiation when it is delivered in small intermittent applications, the effect being an endarteritis obliterans that disturbs the circulation. Irradiation carried to a certain point produces permanent alopecia of the eyelashes. Larger doses of x-rays will produce iritis, choroiditis and corneal ulcer, and even marked scar contractions. Most of the

older roentgenologists have such monuments to their early efforts in therapeutic irradiation around the eyes. Small repeated doses may be more harmful than a single large application.

Dr. Laura A. Lane, Ann Arbor, Mich.: While I do not work with x-rays, I have had considerable experience with radium. During the last eleven years I have treated three patients with herpes zoster ophthalmicus. My results have been better following my use of radium than they were before I began using it. Previously I had two cases. One of the reasons for using radiotherapy is the analgesic effect. I know of no treatment that will relieve pain as quickly as radiotherapy, with small doses of either x-rays or radium. Another reason for using radiotherapy is that the resulting scar is very much finer than scars from other methods of treatment. Dr. de Schweinitz has called attention to this on more than one occasion. The method of applying radium therapy is painless, and the course of the disease is greatly shortened. I should be afraid of x-rays in cases in which there is a tendency to an elevation of intra-ocular tension. There are reports in the literature of hemorrhagic glaucoma following the use of x-rays, and at times I have had difficulty with radium, but not to the extent that I have had with x-rays. I prefer to make the dose small. One large dose is best in malignant conditions, but not the best in benign conditions when a stimulating effect is desired.

Dr. François Badeaux, Montreal: I believe what Dr. Pendergrass said about small doses, for they can give rise to a cataract, as observed on animals by German ophthalmologists, but in four years of treatment I never found a cataract in my patients. Radium may be very efficacious, but I am not used to it and have observed glaucomas resulting from its use more often than from the use of x-rays, but I believe that results may be obtained with radium.

II. Herpes Corneae, with Special Reference to Its Treatment with Tincture of Iodine. Trygve Gundersen, Boston.

This paper was published in full in the February 1936 issue of the Archives, page 225.

Intracapsular Extraction of Cataract in the Average Practice: Report of One Hundred Cases in Which Verhoeff's Method Was Used. Dr. S. J. Beach and Dr. W. R. McAdams, Portland, Maine.

This paper was published in full in the January 1936 issue of the Archives, page 95.

Artificial Fever Therapy in Cases of Ocular Syphilis. Dr. Arthur M. Culler and Dr. Walter M. Simpson, Dayton, Ohio.

This paper was published in full in the April 1936 issue of the Archives, page 624.

Trainor Operation for Lid Ptosis. Dr. Melverton E. Trainor, Los Angeles.

Operative intervention is indicated in either congenital or acquired ptosis. Fifty-five operations have been devised for the correction of

this condition. Ten years ago, I became dissatisfied with the results obtained in the cases in which I had tried operative treatment. I believed it possible to get a pulley-acting connection between the lid and the eyeball. To obtain this I used the superior border of the fibrous plate of the upper lid and the superior rectus muscle. A strip of the superior border of the tarsus 2 mm. wide by 10 or 12 mm. long, consisting of fibrous tissue almost completely surrounded by conjunctiva, is separated from the middle half of the superior tarsal border of the everted lid mesial end attached. This strip is pulled under the superior rectus, near its attachment to the eyeball, and its tip stitched into its original attachment.

DISCUSSION

DR. ARNOLD KNAPP, New York: Dr. Trainor's original idea of passing the superior rectus muscle through a horizontal gap in the tarsus must result in raising the upper lid, as shown by photographs taken in operative cases. I cannot, however, see how the gap through the tarsus can remain open and act as a pulley; it seems to me that the effect achieved must be due to adhesion of the upper lid to the superior rectus muscle.

Practically the same effect is produced by the Motais operation. Only this firm adhesion can be responsible for any effect obtained in raising the lid when the levator is paralyzed. The great objection to this type of operation is the lagophthalmos that may produce unpleasant symptoms. I feel that resection of the levator muscle and partial excision of the tarsus, as suggested by Blascovitz and Gillet de Grandmont, are a better procedure for the operative relief of ptosis.

DR. E. C. ELLETT, Memphis, Tenn.: Seventy-eight operations for ptosis have been described, and of these I have had personal experience with only a few and none at all with the operation described by the assayist. There are three things to be especially borne in mind in contemplating an operation for ptosis, namely, the function of the levator, of the superior rectus and of the frontalis muscles, since many of the operations contemplate the use of one of these muscles. The operations can be grouped according to whether they depend on the use of one of these muscles or on other tissues to remedy the defect. I have fared best with the Motais operation as modified by Shoemaker, which utilizes the superior rectus muscle. There are several objections to the ordinary Motais operation, the first being the difficulty in getting the slip of muscle to adhere firmly, there being a great tendency for it to pull loose, which nullifies the effect of the operation. The removal of a small piece of sclera with the end of the slip of muscle gives a much better hold for sutures than the muscle fibers alone and also makes an early and firm adhesion more likely. Another trouble is overcorrection with the result that the eye does not close well, especially during sleep, and some corneal irritation is apt to result. Another trouble is that sometimes the lid is pulled up to a point in the center, making an unpleasant appearance. Most of these objections are overcome in the modification suggested by Shoemaker. The upper edge of the tarsus is exposed by an incision through the skin, and the superior rectus is exposed by an incision through the conjunctiva. Without separating a slip of the muscle, the edge of the tarsus is sutured to the muscle near its scleral insertion by a firm mattress suture.

NEW YORK ACADEMY OF MEDICINE, SECTION OF OPHTHALMOLOGY

Nov. 18, 1935

JOHN DUNNINGTON, M.D., *Chairman*

LE GRAND H. HARDY, M.D., *Secretary*

GOLD PARTICLES IN THE CORNEA. DR. CLYDE MCDANNALD.

This paper will be published in full in a later issue of the ARCHIVES.

ANIRIDIA: REPORT OF THREE CASES IN ONE FAMILY. DR. JAMES W. SMITH.

Four cases of aniridia are presented, occurring in a mother aged 40 and her three sons, aged 20, 18 and 13. The mother was warned after the birth of the first son that any child born subsequently would also have aniridia. All four patients had poor vision, bilateral aniridia and horizontal nystagmus. Intra-ocular tension was increased in the eyes of the mother and the eldest son.

In the mother bilateral corneal clouding and right perinuclear cataract were present. Vision in the right eye was equal to perception of form at 10 inches (25.4 cm.); vision in the left eye corrected by an aphakic lens was 10/200. In the sons, the best vision was 20/200. Vision could not be improved with correcting lenses or with horizontal stenopaic slits, pinhole spectacles or telescopic lenses. Photophobia was not marked in any of the patients in average bright illumination.

Cases cited are from the literature proving that the influence of heredity is greater in aniridia than in any other ocular malformation. It is the duty of the ophthalmologist to warn such patients against having children.

DISCUSSION

DR MARK J. SCHOENBERG: Most patients with aniridia suffer from glare and nystagmus. Dr. Smith's patients have nystagmus in daylight, but the eyes remain quiet when in semidarkness. This observation suggests that a specially constructed contact glass, opaque throughout except in its center, will reduce the glare by reducing the amount of light entering the eye. The transparent central area should have a diameter of about 3 mm., and the opaque part could be stained the color of the iris.

DR. RAMÓN CASTROVIEJO: A procedure somewhat similar to the one described by Dr. Schoenberg was tried in the treatment of a child brought to me about seven months ago. At that time the child was only 2 months old. The parents had discovered unusually large pupils and thought there was something wrong with the baby's eyes. Examination disclosed aniridia and marked nystagmus in both eyes. Since it is not definitely known whether poor vision and nystagmus in patients with this condition are due to a congenital malformation of the optical pathways or to an underdevelopment of central vision caused by the excess of light penetrating the eye, it was considered

worth while to give the child pinholes 3 mm. in diameter, mounted in special goggles, which shut off all the light except that penetrating through the pinholes. At first the child was irritable when wearing the glasses but soon got accustomed to wearing them so that there was no apparent discomfort. Examination of the patient a few weeks ago revealed that the nystagmus had decreased somewhat.

DR. EMANUEL M. JOSEPHSON: Aniridia and other types of congenital defects of the eye have been produced by Kusagawa by injecting naphthalene into the ovum. He found that various lesions of the eye, such as cataracts, aniridia, ectopia lentis and arachnodactylia, were associated with lesions in other organs, especially with lesions of the bones, and he followed their heredity through three successive generations. I have had occasion to confirm his findings and to produce similar lesions with di-nitrophenol. I wish to call attention to the short fingers and fusiform phalanges of the three patients presented, and to ask Dr. Smith to speak of any further pathologic observations which might parallel Kusagawa's experimental findings.

DR. JAMES W. SMITH: I want to thank Dr. Schoenberg and Dr. Castroviejo for their suggestions and will be glad to try them in the treatment of my patients. All of the mechanical devices tried thus far have failed to effect improvement of the visual acuity.

In reply to the last speaker, I may say that several members of the section examined the hands of these patients, and all agreed that the fingers were of normal size.

CONJUNCTIVITIS DUE TO FUSOSPIROCHETAL INFECTION. DR. J. H. DUNNINGTON and DR. D. L. KHORAZO.

This paper will be published in full in a later issue of the ARCHIVES.

EXOPHTHALMOS IN GENERAL DISEASE. DR. ALBERT D. RUEDEMANN.

This paper will be published in full in a later issue of the ARCHIVES.

HEMANGIOBLASTOMATOSIS OF THE RETINA AND CENTRAL NERVOUS SYSTEM WITH VISCERAL LESIONS (VON HIPPEL-LINDAU DISEASE). DR. SAMUEL BROCK, DR. CORNELIUS G. DYKE and DR. CHARLES DAVISON.

In 1904 von Hippel described angiomatosis of the retina. In the early stages of this disease examination of the fundus shows the presence of tortuous vessels, often in pairs, running to one or more reddish or grayish elevations; hemorrhages are frequent. First one eye, then the other is affected. Secondary changes take place, such as detachment of the retina, gliosis and secondary glaucoma, and ultimately blindness results.

In 1926 Lindau pointed out that the retinal lesions were followed years later by the appearance of symptoms of disease of the viscera and central nervous system, due to the development of cysts in the pancreas and kidney, sometimes hypernephroma, and hemangioblastomas in the cerebellum, brain stem or spinal cord. The disease is apt to be familial.

In this case, a boy of 14 (1911) became blind first in one and then the other eye, over a period of seven years (1918). Drs. F. J. C. Fitzgerald and John E. Weeks found the following changes in the fundus (1912-1913): engorgement of the vessels with hemorrhages, the presence of small grayish masses and detachment of the retinas. Gradually calcification of the uveal tract occurred. In the twenty-three years following the onset (1911-1934) many gastro-intestinal, circulatory and nervous symptoms made their appearance. These consisted of abdominal pains, weakness, drowsiness, tremors and clonic movements, headaches, incoordination, emaciation, defects in sensation and finally convulsions. In 1928 a cystadenoma of the pancreas was removed. The diagnosis of von Hippel-Lindau disease was made in 1931. The patient died in 1934 because of involvement of vital centers in the medulla oblongata.

Biopsy and autopsy revealed cystadenoma of the pancreas, innumerable cysts of the peritoneum, engorgement of the blood vessels of the abdominal viscera, hypernephroma of the right kidney, cyst of the epididymis, hemangioblastoma of the retina, brain stem and spinal cord and syringomyelia.

The examinations of the fundi of one sister of 48 years and two half-sisters of 28 and 32 years (November 1935) gave entirely negative results.

DISCUSSION

Dr. Ernest Krug: Diagnosis from the fundus picture alone is not easy unless one finds that the patient has the characteristic retinal cystic mass with the associated large artery and vein. There should be a cerebellar tumor with familial incidence or a retinal angioma with a cerebellar tumor with or without familial incidence to make the diagnosis of Lindau's syndrome. After the condition of the eye has advanced to the stage of retinal detachment with secondary glaucoma, one cannot always definitely state that one deals with this disease.

Dr. Arthur J. Bedell: I wish to call attention to two things: First, the angiomas in angiomatosis of the retina are, if the disease is seen early, definitely outlined with a draining vein and an entering artery. Later there is a widespread exudate. Still later, there is partial detachment of the retina, as was shown in some of the illustrations in the article published by me in 1931. In the final stage there is widespread multilobular and complete detachment of the retina.

Second, I cannot understand the authors' statement that the patient had angiomas in the eye and that therefore they could predict similar findings in other parts of the body. In the last case of so-called Lindau's disease which I saw, there were no retinal lesions, and yet on autopsy the typical changes were found in the brain. I do not feel that one is justified in concluding that angiomatosis of the retina is of necessity part of this lesion, which may become general or remain localized in a single organ like the brain.

Dr. Samuel Brock: Dr. Bedell's remarks are very interesting. For some time, fragmentary forms of hemangioblastomatosis have been recognized. One rarely encounters the full-blown picture. Witness the fact that hemangioblastoma of the cerebellum is often found as a single lesion, while the fully developed von Hippel-Lindau syndrome is most unusual.

As regards the histologic aspects, I must take issue with Dr. Bedell because I think that the strands of endothelial cells here are very typical of the histologic picture described by Lindau. Moreover, the clinical history is characteristic. A young person goes blind in one eye and then in the other eye. A similar condition may be present in his siblings. In the early stages retinal examination shows tortuous vessels coursing to a reddish or grayish mass, with hemorrhages or, later, secondary glaucoma, detached retina, organized gliosis and other lesions. A cyst of the pancreas then develops, and then signs of invasion of the central nervous system, usually referable to the cerebellum or spinal cord. One should at this point make the diagnosis of the von Hippel-Lindau syndrome. The clinical picture is unique. While the changes are early and confined to the retina, the diagnosis may be most difficult. If one knows the history of the disease, the diagnosis is simple in the later phases.

Dec. 16, 1935

JOHN DUNNINGTON, M.D., *Chairman*

LE GRAND H. HARDY, M.D., *Secretary*

REMOVAL OF XANTHELASMA WITH CHROMIC ACID. DR. A. E. DAVIS.

My method of removing xanthelasma with chromic acid is as follows:

1. Leave a few crystals of chromic acid in a small container in the open over night that they may deliquesce.

2. Cleanse the eyelid with alcohol and inject subcutaneously a 2 per cent solution of procaine hydrochloride.

3. Dip a sharp-pointed probe in the liquid chromic acid; fuse it on the probe in an alcohol flame; make punctures in the skin 2 mm. apart over the entire growth. The probe must be dipped in acid after each puncture.

4. Apply a dry dressing for one day. Sometimes three or four séances are necessary to remove the growth.

DISCUSSION

DR. RAYMOND E. MEEK: It seems to me that the use of the high frequency current for the removal of xanthelasma is simpler, and the results are comparable.

DR. W. GUERNSEY FREY: There is practically no scar if xanthelasma is carefully excised.

EPIBULBAR SARCOMA TREATED BY EXCISION. DR. H. H. TYSON.

E. M., a colored woman aged 45, was struck on the temporal side of her right eyeball by a twig of a tree eleven years ago. The trauma was followed by discoloration at the site of the injury, which remained quiescent for ten years. During the past year, a pigmented growth appeared, extended to the margin of the cornea and spread rapidly over

the cornea to the pupillary area. The patient declined enucleation but consented to the removal of tissue for examination. The excised tissue was placed in Zenker's solution, and Dr. Smoleroff rendered a report of melanosarcoma, a report concurred in by four pathologists.

DISCUSSION

DR. JULES WARREN SMOLEROFF: This slide represents a low power magnification of a microscopic cross-section of the growth, showing how extremely vascular it is, as was seen in the examinations with the slit lamp. All the blood vessels are much engorged with blood. These are the groups of tumor cells in whorls and strands, intermixed with which may be seen spots of pigment—large masses of pigment, with smaller masses and strands and smaller dots placed throughout all the cell groups. The most striking thing is the apparent invasion of the lymphatic spaces, indicating that the tumor is of a rather malignant type.

DR. BERNARD SAMUELS: Dr. Tyson was good enough to send me a specimen of the excised tissue for microscopic examination. I am of the opinion that this growth was derived from a nevus. It has all the characteristics of an epibulbar melanosarcoma of such origin. It demonstrates how resistant the sclera and cornea are to invasion by an epibulbar tumor in spite of the fact that the tumor may extend over a wide area of the surface. The danger of a tumor of this type consists not only in the invasion of the sclera or the cornea but in the tendency to grow backward and invade the deep orbital tissues. I presume that if there should be a local recurrence it would probably be a posterior one in the deeper structures, for it seems that the growth has reached a point beyond the line of insertion of the rectus muscle.

DR. A. E. DAVIS: I have observed a similar instance, in which the eye was extensively invaded two years after local excision of the tumor.

RECONSTRUCTION OF THE ORBIT FOLLOWING EXENTERATION. DR. I. GOLDSTEIN.

This paper will be published in full in a later issue of the ARCHIVES.

CONCENTRATION OF LYSOZYME IN TEARS IN ACUTE AND CHRONIC CONJUNCTIVITIS. DR. RICHARD THOMPSON and DR. EDWARD GALLARDO.

The average amount of lysozyme in tears from eyes with acute or chronic conjunctivitis or keratitis is markedly lower than that in tears from normal eyes. However, in many of the pathologic cases the concentration falls within the normal limits.

The lysozyme of the tears apparently originates in the lacrimal glands, as is generally supposed, rather than in the mucous glands of the conjunctivae.

DISCUSSION

DR. CONRAD BERENS: The amount of lysozyme in tears is of great importance to surgeons because some use antiseptics before and after operation. This problem was brought to my attention through the work of Bernea and Segaller-Miron, who use no antiseptic preoperatively or postoperatively in operations on the eye. Some authors believe that

certain antiseptics destroy the active principle of lysozyme; on the other hand, silver apparently increases the number of leukocytes in the secretion, and these are said to contain large amounts of lysozyme. I should be interested in hearing what Dr. Thompson and Dr. Gallardo believe in regard to the use of antiseptics in operations on the eyes.

Anderson in 1932 seemed to agree with Thompson and Gallardo that when there is disease of the cornea the lysozyme in the tears may be low, and his work indicated that disease may be more serious in an eye in which the lysozyme is low. He found that vitamin A apparently increased the lysozyme in tears; I should like to know if this has been found to be true.

Rhinologists have long contended that the mucin of the nose should be left undisturbed because of its inhibitory action on the growth of nasal bacteria. I wonder whether a similar inhibition does not exist in the eye.

Have Dr. Thompson and Dr. Gallardo employed any method of rapidly stimulating the secretion in the lacrimal gland other than that of using onions—for example, diathermy, massage or the application of ethylmorphine hydrochloride?

DR. RICHARD THOMPSON: I think Dr. Berens has answered some of his own questions regarding collyria: In some cases irritating antiseptics do decrease the lysozyme in the tears. It is possible that it is better not to use too irritating an antiseptic previous to operation. I cannot be dogmatic about that, as I do not know whether the antilysozyme effect of an antiseptic will counterbalance the antiseptic effect. We have not done any work on vitamin A. We have tested the aqueous and not found lysozyme in it. We have not studied any procedure for stimulating the production of tears other than the use of onions.

TREATMENT OF RETINOBLASTOMA BY DIVIDED OR PROTRACTED DOSAGE WITH ROENTGEN RADIATION. DR. HAYES E. MARTIN and DR. ALGERNON B. REESE.

This paper will be published in full in a later issue of the ARCHIVES.

ROYAL SOCIETY OF MEDICINE, LONDON, SECTION OF OPHTHALMOLOGY

Jan. 10, 1936

MR. RANSOM PICKARD, C.B., M.S., *President*

TWO BROTHERS WITH THE LAURENCE-MOON-BIEDL SYNDROME. MR. LESLIE PATON.

Two years ago Mr. Arnold Sorsby showed two typical families in which there were six separate patients with the Laurence-Moon-Biedl syndrome. In association with Cockayne and Krestin, Sorsby has described these two families in more detail. Since Laurence and Moon's original paper appeared in the *Ophthalmic Review* in 1866, a number of reports of cases have been published. Not until 1922 did Biedl show the true interrelationship of the different symptoms.

The two patients shown tonight belong to a family of four. The father, mother and all their near kin are normal. The other two children are a girl aged 11 and a boy aged 7, both said to be normal in appearance and in vision.

The elder boy of the two now shown is aged 14, and his vision is only 6/60. He has vertical nystagmus, which is not increased on lateral or vertical deviations, but the oscillations become more rapid on attempts at ophthalmoscopic examination. When the boy is excited there is occasional nodding of the head. The pupillary reactions are normal. Retinal defects are certainly present, but ophthalmoscopic examination is very difficult. The boy shows the characteristic marked obesity. The little finger of his left hand seems to have one carpal bone missing, and the fingers are tapering. The toes are normal in number, but the three outer toes on each foot are shortened. The palatal arch is very high. The boy has had difficulty in reading the blackboard at school ever since he was 10 years old, and he is very retarded mentally.

The younger boy's age is 12, and he has similar defective vision with a nystagmus which is mainly horizontal, though there is a rotational element in it. It is very irregular in incidence and is more definitely accompanied by head-nodding than is the nystagmus of his brother. His pupils are active. There is an obvious retinal defect as well as mental backwardness with obesity. He has six toes on each foot.

The disease is familial. The fovea may be the area most affected, and the changes may vary from slight macular stippling to large macular colobomas. The retina may be affected generally, and may show all gradations from slight retinal atrophies with but little pigmentary disturbance to conditions which can be described as typical retinitis pigmentosa. Hence night blindness is not uncommon. Nystagmus is not met with in all instances; it is more likely to be observed in cases in which the macular defects predominate. In Willi's cases nystagmus was present, and the macula lutea was said to be undeveloped; there were also webbed fingers and toes. The sella turcica was enlarged, and dark adaptation and color vision were very defective. Moran thinks cases of the latter type are due to intra-uterine syphilis occurring very early in fetal life, and he is not deterred by the report of a negative Wassermann reaction. In the *British Journal of Ophthalmology* (**19:** 65 [Feb.] 1935) Sorsby drew attention to the association of macular colobomas with skeletal defects. Weill and Sayeur found an increase in the hormone of the anterior lobe of the pituitary gland and a deficiency in the hormone of the posterior lobe and in the testicular hormone. For these reasons, efforts at treatment have been focused on the sellar region. I think, however, that though all the patients with this syndrome show evidence of hypopituitarism the primary defect must date back to the beginnings of fetal life and must be due to disturbances in the relationship of the genes in one or more chromosomes.

DISCUSSION

MR. ARNOLD SORSBY: There is no basis for the view held by Bailliart that the lesions in cases of this syndrome are of congenital origin. The vast majority of the cases are familial, more than one

child in a family being affected, and the characteristic is recessive. So far, the number of cases is 108. Consanguinity is present in 33 per cent, a very large proportion, considering that among the general population consanguinity is present in only 0.5 per cent. The appearances of the fundus fall into the group of pigmentary degeneration of the retina. Optic atrophy is frequently present, but it takes some time to become established.

ECLAMPTIC DETACHMENT OF THE RETINA. MR. J. H. DOGGART.

The renal system is seriously impaired and organs other than the kidneys are affected in many cases of eclampsia. Extensive edema of the retina has been seen in eclamptic patients in whom renal efficiency was not reduced. Hence it is not surprising that the appearance of the fundus in eclampsia can differ so much from that expected in chronic nephritis. In retinal detachment associated with eclampsia four points of distinction must be emphasized: (1) the rapidity of onset; (2) the abundance of the subretinal fluid, which may push the retina forward without folds so that its appearance is that of a full-blown sail; (3) the fact that extensive bilateral detachment may occur with little or no hemorrhage or exudate on the surface of the retina; (4) the good prognosis.

Schiötz investigated ophthalmoscopically 6,800 pregnant or puerperal women, including 132 with eclampsia. Only seven showed retinal detachment, and in three of these there was no evidence of retinitis. Of these three, two had unilateral detachment which continued for years; one woman with a bilateral detachment made a quick recovery. Clapp reported on six patients with retinal detachment in eclampsia, all of whom recovered good sight and had normal visual fields.

About five years ago I saw a primipara, 26 years of age, with bilateral detachment. Soon after admission to the hospital in severe toxemia of pregnancy she had two convulsions, and the subcutaneous tissues all over the body were intensely edematous. Surgical induction a few days later resulted in stillbirth of the fetus within twenty-four hours. There was detachment of the upper part of the right retina; the detached part was very dark and came forward into the vitreous. In the left eye the detachment was mainly in the upper part. No hemorrhage or exudates were seen in either fundus. The systolic blood pressure at this time was 210. A week later the detachment on the right had subsided, leaving only a moderate amount of myopic pigmentary degeneration at the macula. In the left eye the detachment was now much smaller and was confined to the lower portion of the retina. At the end of another week the right eye remained with its retina back in position. In the left eye the detachment was still smaller, and the hemorrhages on this part of the retina were rapidly diminishing. A fortnight later the hemorrhages had been entirely absorbed, and only a very small shallow detachment remained in the lower part of the retina. Soon afterward the retina was completely back in its normal position and showed a few scattered spots of pigment. With her right eye the patient was able to see part of the 6/12 line with a —11.0 sphere. The vision in the left eye was 6/6 unaided. The visual fields were full. Six of the seven cases of eclamptic detachment recorded by

Schiötz were observed in primiparas. On the other hand, Mr. Foster Moore noted that multiparas were more liable than primiparas to suffer from the retinitis of pregnancy.

DISCUSSION

MR. RANSOM PICKARD: In the second year of the war I never saw retinitis in a patient with nephritis among hundreds with that disease. However, I could not keep the patients under observation longer than a week or ten days.

MR. D. LEIGHTON DAVIES: I saw a patient in her first pregnancy who had severe albuminuria with white exudates and hemorrhages in the retinas. She improved but did not quite regain her normal vision—6/24 in each eye. Two or three years later she again became pregnant, and at the seventh month eclampsia developed. Then she had double retinal detachment of an extensive nature. Vision was reduced to mere perception of light. There was intense edema over the whole body, and the face was scarcely recognizable. Her general condition improved, and within a month the double detachment had disappeared and the visual fields were full.

MR. CHARLES GOULDEN: I have brought for demonstration a picture showing the after-results of a detachment of the retina in eclampsia in a primipara aged 23. When I was called to see her, she had a detachment of the retina in the outer and upper part of each eye, which was very extensive. She subsequently recovered so that the vision in the right eye was normal and there was about half the normal visual acuity in the left.

MR. J. W. TUDOR THOMAS: My experience has been that in cases of eclampsia detachment could be found more frequently if looked for a short time after it became necessary to induce labor. In most cases the detachment cleared up with remarkable speed, and in a few days one could not tell that there had been detachment.

MR. F. W. LAW: It would be interesting to know, in view of the peculiar changes, whether Mr. Goulden and others have considered the possibility of retinal detachment's being secondary to choroidal exudation and occurring, therefore, in an anatomic plane different from that of the detachment one sees with holes in the retina.

MR. J. H. DOGGART: I have never read of eclampsia in which there was a hole in the detached retina. In a paper of composite authorship in Germany there is mention of holes but there is no description of a case to support it. With such a rapid and extensive exudation, it would not be surprising if holes occurred, especially in a person having a retina which is thin at the periphery. I think Mr. Law's anatomic suggestion is a good one, as the mere fact of lifting up layers of the retina is not enough to account for the condition.

Book Reviews

Radium Treatment of Skin Diseases, New Growths, Diseases of the Eyes and Tonsils. By Francis H. Williams. Price, $2. Pp. 118, with 12 illustrations. Boston: The Stratford Company, 1935.

Williams, who has been actively interested in radium therapy for thirty years, has briefly summarized the results of his work.

The section devoted to diseases of the eye comprises twenty-eight pages. In addition to a description and photograph of his apparatus for applying radium to the eye and its adnexa, he gives short résumés of some of his cases, which include cases of lipoma of the conjunctiva, new growths of the lids, ectropion, corneal opacities, cataracts and retinitis pigmentosa. One gains the impression that radium was of distinct value in treating the various conditions of the lid and in partially clearing corneal opacities. It is impossible to accept his statement as to the value of radium in the treatment of cataract because of the paucity of the patients treated and the insufficiency of the data presented. The one case of retinitis pigmentosa in which there was a slight improvement of vision in the left eye after two years' treatment and in which the fields were said to be greatly improved is not convincing.

Williams emphasizes the comparative safety of radium, as contrasted with the roentgen rays, both for the patient and for the operator.

A short bibliography is appended.

W. F. Duggan.

CORRECTION

In the transactions of the American Ophthalmological Society in the April issue (*Arch. Ophth.* **15**:766, 1936) the name of Dr. J. Wilkinson Jervey, of Greenville, S. C., was inadvertently omitted on page 777 at the beginning of the second new paragraph, "It has been discovered, etc."

Directory of Ophthalmologic Societies *

INTERNATIONAL

International Association for Prevention of Blindness

President: Prof. F. de Lapersonne, 217 Faubourg St. Honoré, Paris.
Secretary-General: Prof. M. Van Duyse, Université de Gand, Gand, Prov. Ostflandern, Belgium.

International Ophthalmologic Congress

Secretary: Dr. E. Marx, Costzeedijk 316, Rotterdam, Holland.
Place: Cairo. Time: December 1937.

FOREIGN

British Medical Association, Section on Ophthalmology

President: Dr. P. E. H. Adams, 6, Holywell, Oxford.
Secretary: Dr. Thomasina Belt, 13, Mitchell Ave., Jesmond, Newcastle-on-Tyne.
Place: Oxford. Time: July 22-24, 1936.

Ophthalmology Society of Bombay

President: Dr. D. D. Sathaye, 127 Girgaum Road, Bombay 4.
Secretary: Dr. H. D. Dastur, Dadar, Bombay 14.
Place: H. B. A. Free Ophthalmic Hospital, Parel, Bombay 12. Time: First Friday of every month.

Ophthalmological Society of the United Kingdom

President: Mr. R. Foster Moore, 53, Harley St., London, W. I.
Secretary: Miss Ida Mann, 7, Wimpole St., London, W. I.

Oxford Ophthalmological Congress

Master: Dr. C. G. Russ Wood, Hill House, Abberbury Rd., Iffley, Oxford, England.
Hon. Secretary-Treasurer: Dr. F. A. Anderson, 12 St. John's Hill, Shrewsbury, England.

Royal Society of Medicine, Section of Ophthalmology

President: Dr. Ransom Pickard, 31, East Southernhay, Exeter, England.
Secretary: Dr. A. Rugg-Gunn, 35, Harley St., London, W. 1.

Société Française d'Ophthalmologie

Secretary: Dr. René Onfray, 6 avenue de la Motte Picquet, Paris 7è.

Society of Swedish Ophthalmologists

President: Prof. F. Berg, Uppsala, Sweden.
Secretary: Dr. K. O. Granström, Södermalmstorg 4 III tr., Stockholm, Sö., Sweden.

German Ophthalmological Society

President: Prof. Lohlein, Jena.
Secretary: Prof. A. Wagenmann, Heidelberg.
Place: Heidelberg. Time: July 6-8, 1936.

Chinese Ophthalmological Society of Peiping

President: Dr. H. T. Pi, Peiping Union Medical College, Peiping.
Secretary: Dr. C. K. Lin, 180 Hsi-Lo-yen, Chienmeng, Peiping.
Place: Peiping Union Medical College, Peiping. Time: Last Friday of each month.

* Secretaries of societies are requested to furnish the information necessary to make this list complete and to keep it up to date.

Tsinan Ophthalmological Society

Chairman: Dr. Eugene Chan, Cheeloo University School of Medicine, Tsinan, Shantung.
Place: Cheeloo University School of Medicine. Time: Last Thursday of alternate months.

NATIONAL

American Medical Association, Scientific Assembly, Section on Ophthalmology

Chairman: Dr. John Green, 3720 Washington Blvd., St. Louis.
Secretary: Dr. Parker Heath, 1553 Woodward Ave., Detroit.
Place: Kansas City, Mo.: Time: May 11-15, 1936.

American Academy of Ophthalmology and Otolaryngology

President: Dr. Frank E. Burch, 408 Peter St., St. Paul.
Executive Secretary-Treasurer: Dr. William P. Wherry, 1500 Medical Arts Bldg., Omaha.
Place: New York. Time: Sept. 26 to Oct. 3, 1936.

American Ophthalmological Society

President: Dr. L. S. Greene, 1710 Rhode Island Ave., N. W., Washington, D. C.
Secretary-Treasurer: Dr. J. Milton Griscom, 2213 Walnut St., Philadelphia.
Place: Hot Springs, Va. Time: June 1-3, 1936.

National Society for the Prevention of Blindness

President: Mr. William Fellowes Morgan, 50 W. 50th St., New York.
Managing Director: Mr. Lewis H. Carris, 50 W. 50th St., New York.

SECTIONAL

New England Ophthalmological Society

President: Dr. James J. Regan, 520 Commonwealth Ave., Boston.
Secretary-Treasurer: Dr. William P. Beetham, 5 Bay State Road, Boston.
Place: Massachusetts Eye and Ear Infirmary, 243 Charles St., Boston, Time: 8 p. m., third Tuesday of each month from November to April, inclusive.

Pacific Coast Oto-Ophthalmological Society

President: Dr. H. G. Merrill, 3245 4th St., San Diego, Calif.
Secretary-Treasurer: Dr. Frederick C. Cordes, 384 Post St., San Francisco.
Place: Del Monte, Calif. Time: Spring, 1936.

Puget Sound Academy of Ophthalmology and Oto-Laryngology

President: Dr. L. H. Klemptner, 509 Olive St., Seattle.
Secretary-Treasurer: Dr. Purman Dorman, Virginia Mason Hospital, Seattle.
Place: Seattle. Time: January 1937.

Rock River Valley Eye, Ear, Nose and Throat Society

President: Dr. W. R. Fringer, 228 S. Main St., Rockford, Ill.
Secretary-Treasurer: Dr. W. H. Elmer, 321 W. State St., Rockford, Ill.
Place: Rockford, Ill., Janesville or Beloit, Wis. Time: Third Tuesday of each month.

Saginaw Valley Academy of Ophthalmology and Otolaryngology

President: Dr. Robert Griswell, 707 Washington Ave., Bay City, Mich.
Secretary-Treasurer: Dr. W. K. Slack, 308 Eddy Bldg., Saginaw, Mich.
Place: Saginaw, Mich., or Bay City, Mich. Time: Second Tuesday of each month, except July and August.

SIOUX VALLEY EYE AND EAR ACADEMY

President: Dr. L. H. Hohf, Yankton, S. D.
Secretary-Treasurer: Dr. J. C. Decker, Francis Bldg., Sioux City, Iowa.

SOUTHERN MEDICAL ASSOCIATION, SECTION ON EYE, EAR, NOSE AND THROAT

Chairman: Dr. William A. Wagner, 914 American Bank Bldg., New Orleans.
Secretary: Dr. O. M. Marchman, Medical Arts Bldg., Dallas, Texas.

SOUTHWESTERN MICHIGAN TRIOLOGICAL SOCIETY

President: Dr. O. B. McGillicuddy, 1908 Capitol Band Tower, Lansing, Mich.
Secretary-Treasurer: Dr. Maurice C. Loree, 120 W. Hillsdale St., Lansing, Mich.
Time: Third Thursday of alternate months.

WESTERN PENNSYLVANIA EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. Leslie R. Hazlett, 100 S. Main St., Butler.
Secretary-Treasurer: Dr. C. W. Beals, 41 N. Brady St., DuBois.

STATE

COLORADO OPHTHALMOLOGICAL SOCIETY

President: A presiding officer is selected for each meeting alternately until all members have served.
Secretary: Dr. Edna M. Reynolds, 227, 16th St., Denver.
Place: Capitol Life Building, Denver. Time: 7:30 p. m., third Saturday of the month, October to April, inclusive.

CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON EYE, EAR, NOSE AND THROAT

President: Dr. George B. Garlick, 144 Golden Hill St., Bridgeport.
Secretary-Treasurer: Dr. Shirley H. Baron, 309 State St., New London.
Time: May, November.

EYE, EAR, NOSE AND THROAT CLUB OF GEORGIA

President: Dr. B. H. Minchew, 701 Elizabeth St., Waycross, Ga.
Secretary-Treasurer: Dr. Edward S. Wright, 1001 Medical Arts Bldg., Atlanta, Ga.
Place: Savannah. Time: May 12-15, 1936.

INDIANA ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. J. R. Dillinger, French Lick.
Secretary: Dr. Frederick V. Overman, 705 Hume-Mansure Bldg., Indianapolis.

IOWA ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. Edwin Cobb, 307 Masonic Temple, Marshalltown.
Secretary-Treasurer: Dr. O. L. Thorburn, 213½ Main St., Ames.
Place: Marshalltown. Time: September 1936.

MICHIGAN STATE MEDICAL SOCIETY, SECTION OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

Chairman: Dr. Parker Heath, 1553 Woodward Ave., Detroit.
Secretary: Dr. D. R. Heetderks, 26 Sheldon Ave., S. E., Grand Rapids.

MINNESOTA ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. H. E. Binger, 350 St. Peter St., St. Paul.
Secretary-Treasurer: Dr. Walter E. Camp, Medical Arts Bldg., Minneapolis.
Place: St. Paul. Time: May 1936.

MONTANA ACADEMY OF OTO-OPHTHALMOLOGY

President: Dr. Edward S. Murphy, Northern Pacific Hosp., Missoula.
Secretary: Dr. A. W. Morse, 507 Phoenix Bldg., Butte.

NEW JERSEY STATE MEDICAL SOCIETY, SECTION ON OPHTHALMOLOGY, OTOLOGY AND RHINOLARYNGOLOGY

Chairman: Dr. C. Coulter Charlton, 124 S. Illinois Ave., Atlantic City.
Secretary: Dr. H. L. Harley, 124 S. Indiana Ave., Atlantic City.

NEW YORK STATE MEDICAL SOCIETY, EYE, EAR, NOSE AND THROAT SECTION

Chairman: Dr. John F. Fairbain, 925 Delaware Ave., Buffalo.
Secretary: Dr. Walter S. Atkinson, 168 Sterling St., Watertown.

NORTH CAROLINA EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. Burton W. Fassett, Geer Bldg., Durham.
Secretary-Treasurer: Dr. Casper W. Jennings, 332 N. Elm St., Greensboro.
Place: Durham. Time: October 1936.

NORTH DAKOTA ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. Trygve Oftedal, 55½ Broadway, Fargo.
Secretary-Treasurer: Dr. F. L. Wicks, 514 6th St., Valley City.
Place: Jamestown. Time: May 1936.

OREGON ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. A. B. Dykman, Medical Dental Bldg., Portland.
Secretary-Treasurer: Dr. Andrew J. Browning, 418 Mayer Bldg., Portland.
Place: Good Samaritan Hospital. Time: Third Tuesday of each month.

RHODE ISLAND OPHTHALMOLOGICAL AND OTOLOGICAL SOCIETY

Acting President: Dr. Nathan Bolotow, 108 Waterman St., Providence.
Secretary and Treasurer: Dr. Gordon J. McCurdy, 122 Waterman St., Providence.
Place: Rhode Island Medical Library. Time: 8:30 p. m., second Thursday in October, December, February and April.

SOUTH CAROLINA SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. R. E. Houston, 103 E. North St., Greenville.
Secretary: Dr. J. W. Jervey Jr., 101 Church St., Greenville.

TENNESSEE ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. W. W. Potter, 601 Walnut St., Knoxville.
Secretary-Treasurer: Dr. W. D. Stinson, 248 Madison Ave., Memphis.

TEXAS OPHTHALMOLOGICAL AND OTO-LARYNGOLOGICAL SOCIETY

President: Dr. T. E. Fuller, 100 W. Board St., Texarkana, Texas.
Secretary: Dr. O. M. Marchman, 1719 Pacific Ave., Dallas.

UTAH OPHTHALMOLOGICAL SOCIETY

President: Dr. V. P. White, 143½ S. Main St., Salt Lake City.
Secretary-Treasurer: Dr. E. B. Fairbanks, Boston Bldg., Salt Lake City.
Time: Third Monday of each month.

VIRGINIA SOCIETY OF OTO-LARYNGOLOGY AND OPHTHALMOLOGY

President: Dr. Emory Hill, 501 E. Franklin St., Richmond.
Secretary-Treasurer: Dr. George G. Hankins, Medical Arts Bldg., Newport News.
Place: Richmond. Time: May 1936.

WEST VIRGINIA STATE MEDICAL ASSOCIATION, EYE, EAR, NOSE AND THROAT SECTION

President: Dr. F. O. Marple, First Huntington National Bank Bldg., Huntington.
Secretary: Dr. J. E. Blaydes, First National Bank, Bluefield.

LOCAL

Academy of Medicine of Northern New Jersey, Section on Eye, Ear, Nose and Throat

President: Dr. B. E. Failing, 31 Lincoln Park, Newark, N. J.
Secretary: Dr. A. Russell Sherman, 671 Broad St., Newark, N. J.
Place: 91 Lincoln Park South, Newark. Time: 8:45 p. m., second Monday of each month, October to May.

Atlanta Eye, Ear, Nose and Throat Society

President: Dr. William O. Martin Jr., 478 Peachtree St., Atlanta, Ga.
Secretary: Dr. A. V. Hallum, 478 Peachtree St., Atlanta, Ga.
Place: Academy of Medicine, 38 Prescott St. Time: Second Friday of each month from October to May.

Baltimore Medical Society, Section on Ophthalmology

Chairman: Dr. William M. Rowland, 906 Cathedral St., Baltimore.
Secretary: Dr. Mary L. Small, 18 W. Read St., Baltimore.
Place: Medical and Chirurgical Faculty, 1211 Cathedral St. Time: 8:30 p. m., fourth Thursday of each month from October to May.

Brooklyn Ophthalmological Society

President: Dr. John H. Bailey, 855 St. Marks Ave., Brooklyn.
Secretary-Treasurer: Dr. George Freiman, 703 Grand St., Brooklyn.
Place: Kings County Medical Society Bldg., 1313 Bedford Ave. Time: Third Thursday in February, April, May, October and December.

Buffalo Ophthalmologic Club

President: Dr. Thurber LeWin, 112 Linwood Ave., Buffalo.
Secretary-Treasurer: Dr. I. J. Koenig, 40 North St., Buffalo.
Time: Second Thursday of each month.

Chattanooga Society of Ophthalmology and Otolaryngology

President: Each member, in alphabetical order.
Secretary: Dr. A. H. Benz, 706 Medical Arts Bldg., Chattanooga.
Place: Mountain City Club. Time: Second Thursday of each month from September to May.

Chicago Ophthalmological Society

President: Dr. Robert B. Blue, 25 E. Washington St., Chicago.
Secretary-Treasurer: Dr. Thomas D. Allen, 122 S. Michigan Ave., Chicago.
Place: Medinah Michigan Avenue Club, 505 N. Michigan Ave. Time: Third Monday of each month from October to May.

Cleveland Academy of Medicine, Section of Ophthalmology and Otolaryngology

Chairman: Dr. A. D. Ruedemann, 2020 E. 93d St., Cleveland.
Secretary: Dr. Fred W. Dixon, 1029 Rose Bldg., Cleveland.
Place: Winton Hotel. Time: Fourth Friday of each month.

Cleveland Ophthalmological Club

Chairman: Dr. A. B. Bruner, 629 Euclid Ave., Cleveland.
Secretary: Dr. M. W. Jacoby, Hanna Bldg., Cleveland.

College of Physicians, Philadelphia, Section on Ophthalmology

Chairman: Dr. John Milton Griscom, 2213 Walnut St., Philadelphia.
Clerk: Dr. Alexander G. Fewell, 1924 Pine St., Philadelphia.
Time: Third Thursday of every month from October to April, inclusive.

COLUMBUS OPHTHALMOLOGICAL AND OTO-LARYNGOLOGICAL SOCIETY

Chairman: Dr. F. W. Thomas, 327 E. State St., Columbus, Ohio.
Secretary-Treasurer: Dr. H. D. Emswiler, 370 E. Town St., Columbus, Ohio.
Place: Athletic Club. Time: First Monday of each month.

DALLAS ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. F. H. Newton, Mercantile Bldg., Dallas, Texas.
Secretary: Dr. Maxwell Thomas, 1719 Pacific Ave., Dallas, Texas.
Place: Dallas Athletic Club. Time: 6:30 p. m., first Tuesday of each month from October to June. The November, January and March meetings are devoted to clinical work.

DES MOINES ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. E. G. Linn, 604 Locust St., Des Moines, Iowa.
Secretary-Treasurer: Dr. Grace Doane, 614 Bankers Trust Bldg., Des Moines, Iowa.
Time: 7:45 p. m., third Monday of every month, September to May.

DETROIT OPHTHALMOLOGICAL CLUB

Chairman: Members rotate alphabetically.
Secretary: Dr. Raymond S. Goux, David Whitney Bldg., Detroit.
Time: 6:30 p. m., first Wednesday of each month.

EASTERN NEW YORK EYE, EAR, NOSE AND THROAT ASSOCIATION

President: Dr. A. W. Greene, 148 Barrett St., Schenectady.
Secretary-Treasurer: Dr. Joseph L. Holohan, 317 State St., Albany.
Time: Third Wednesday in October, November, March, April, May and June.

FORT WORTH EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. T. L. Goodman, 602 W. 10th St., Fort Worth, Texas.
Secretary-Treasurer: Dr. Van D. Rathgeber, 1012 Medical Arts Bldg., Fort Worth.
Place: Medical Hall, Medical Arts Bldg. Time: 7:30 p. m., first Friday of each month except July and August.

GRAND RAPIDS EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. John H. McRae, 26 Sheldon Ave., S. E., Grand Rapids, Mich.
Secretary-Treasurer: Dr. Robert G. Laird, 307 Metz Bldg., Grand Rapids, Mich.
Place: Various local hospitals. Time: Third Thursday of alternating months. September to May.

HOUSTON ACADEMY OF MEDICINE, EYE, EAR, NOSE AND THROAT SECTION

President: Dr. R. M. Hargrove, 1202 Esperson Bldg., Houston, Texas.
Secretary: Dr. J. C. Dickson, 1617 Medical Arts Bldg., Houston, Texas.
Place: Medical Arts Bldg., Harris County Medical Society Rooms. Time: 8 p. m., second Thursday of each month from September to June.

INDIANAPOLIS OPHTHALMOLOGICAL AND OTOLARYNGOLOGICAL SOCIETY

President: Dr. J. C. Daniel, 23 E. Ohio St., Indianapolis.
Secretary: Dr. Kenneth L. Craft, 23 E. Ohio St., Indianapolis.
Place: University Club. Time: 6:30 p. m., second Thursday of each month from October to May.

KANSAS CITY SOCIETY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. H. B. Davis, 1101 Grand Ave., Kansas City, Mo.
Secretary: Dr. Byron Black, Professional Bldg., Kansas City, Mo.
Time: Third Thursday of each month from September to May. The November, January and March meetings are devoted to clinical work.

LONG BEACH EYE, EAR, NOSE AND THROAT SOCIETY

Chairman: Dr. Clyde E. Harner, 110 Pine Ave., Long Beach, Calif.
Secretary-Treasurer: Dr. Paul T. Southgate, 704 Professional Bldg., Long Beach, Calif.
Place: Professional Bldg. Time: Last Wednesday of each month from October to May.

LOS ANGELES SOCIETY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. Walter R. Crane, 756 S. Broadway, Los Angeles
Secretary-Treasurer: Dr. Pierre Viole, 1930 Wilshire Blvd., Los Angeles.
Place: Los Angeles County Medical Association Bldg., 1925 Wilshire Blvd., Time: 6:30 p. m., fourth Monday of each month from September to May, inclusive.

LOUISVILLE EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. J. S. Bumgardner, Heyburn Bldg., Louisville, Ky.
Secretary-Treasurer: Dr. Max Bornstein, Heyburn Bldg., Louisville, Ky.
Place: Brown Hotel. Time: 6:30 p. m., second Thursday of each month from September to May, inclusive.

MEDICAL SOCIETY OF THE DISTRICT OF COLUMBIA, SECTION OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

Chairman: Dr. Arthur M. Zinkham, 815 Connecticut Ave., Washington.
Secretary: Dr. E. J. Cummings, 1835 I St., N. W., Washington.
Place: 1718 M St., N. W. Time: 8 p. m., third Friday of each month from October to April, inclusive.

MEMPHIS SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

Chairman: Each member, in alphabetical order.
Secretary: Dr. R. O. Rychener, 130 Madison Ave., Memphis, Tenn.
Place: Eye Clinic of Memphis Eye, Ear, Nose and Throat Hospital. Time: 8 p. m., second Tuesday of each month.

MILWAUKEE OTO-OPHTHALMIC SOCIETY

President: Dr. Hilmar G. Martin, 231 W. Wisconsin Ave., Milwaukee.
Secretary-Treasurer: Dr. Herbert G. Schmidt, 238 W. Wisconsin Ave., Milwaukee.
Place: University Club. Time: 6 p. m., second Tuesday of each month.

MINNEAPOLIS OPHTHALMOLOGICAL SOCIETY

Chairman: Each member in alphabetical order.
Secretary: Dr. C. W. Rucker, 527 Medical Arts Bldg., Minneapolis.
Place: Hennepin County Medical Society rooms. Time: 6:30 p. m., fourth Monday of each month, October to May, inclusive.

MONTGOMERY COUNTY MEDICAL SOCIETY

Chairman: Dr. W. J. Blackburn, 663 Reibold Bldg., Dayton, O.
Secretary-Treasurer: Dr. F. J. Driscoll, 986 Reibold Bldg., Dayton, O.
Place: Van Cleve Hotel. Time: 6:30 p. m., bimonthly, first Tuesday from October to June, inclusive.

Montreal Ophthalmological Society

President: Dr. Stuart Ramsay, 1496 Mountain St., Montreal, Canada.
Secretary: Dr. J. Rosenbaum, 1396 St. Catherine St., West, Montreal, Canada.
Time: Second Thursday of October, December, February and April.

Nashville Academy of Ophthalmology and Otolaryngology

Chairman: Dr. Kate S. Zerfoss, 119, 7th Ave., N., Nashville, Tenn.
Secretary-Treasurer: Dr. Fowler Hollabaugh, Doctors Bldg., Nashville, Tenn.
Place: St. Thomas Hospital. Time: 8 p. m., third Monday of each month from October to June.

New Orleans Ophthalmological and Otolaryngological Society

President: Dr. R. H. Fisher, Chess and Checker Club, New Orleans.
Secretary-Treasurer: Dr. H. F. Brewster, 837 Gravier St., New Orleans.
Place: Eye, Ear, Nose and Throat Hospital. Time: Third Thursday of each month from October to June.

New York Academy of Medicine, Section of Ophthalmology

Chairman: Dr. John H. Dunnington, 30 W. 59th St., New York.
Secretary: Dr. LaGrand H. Hardy, 30 E. 40th St.,, New York.
Time: 8:30 p. m., third Monday of every month from October to May, inclusive.

Omaha and Council Bluffs Ophthalmological and Oto-Laryngological Society

President: Dr. John H. Judd, 107 S. 17th St., Omaha.
Secretary-Treasurer: Dr. W. A. Cassidy, 107 S. 17th St., Omaha
Place: Omaha Club, 20th and Douglas Sts., Omaha. Time: 6 p. m., dinner; 7 p. m., program; third Wednesday of each month from October to May.

Passaic-Bergen Ophthalmological Club

President: Dr. E. C. Reynolds, 657 Main Ave., Passaic, N. J.
Secretary-Treasurer: Dr. T. A. Sanfacon, 80 Park Ave., Paterson, N. J.
Place: Paterson Eye and Ear Infirmary. Time: 9 p. m., last Friday of every month, except June, July and August.

Philadelphia County Medical Society, Eye Section

Chairman: Dr. Charles R. Heed, 1205 Spruce St., Philadelphia.
Secretary: Dr. Sidney L. Olsho, 235 S. 15th St., Philadelphia.
Time: First Thursday of each month from October to May.

Pittsburgh Ophthalmological Society

President: Dr. Glendon E. Curry, Westinghouse Bldg., Pittsburgh.
Secretary: Dr. George H. Shuman, Park Bldg., Pittsburgh.
Place: Pittsburgh Academy of Medicine Bldg. Time: Fourth Monday of each month, except June, July, August and September.

Pittsburgh Slit-Lamp Society

President: Dr. W. W. Blair, 121 University Pl., Pittsburgh.
Secretary: Dr. George H. Shuman, Park Bldg., Pittsburgh.
Place: Falk Clinic. Time: 4 p. m., second Friday of every month, except June, July, August and September.

Richmond Ophthalmological and Oto-Laryngological Society

President: Dr. Robert H. Courtney, Professional Bldg., Richmond, Va.
Secretary: Dr. Richard W. Vaughan, Medical Arts Bldg., Richmond, Va.
Place: Westmoreland Club. Time: 6 p. m., second Monday of each month from October to May.

Rochester Eye, Ear, Nose and Throat Society

President: Dr. R. E. Elliott, 78 S. Fitzhugh St., Rochester, N. Y.
Secretary-Treasurer: Dr. Raphael Farber, 280 Monroe Ave., Rochester, N. Y.
Place: Rochester Medical Association, 113 Prince St. Time: 8 p. m., third Monday of each month from October to May.

St. Louis Ophthalmic Society

President: Dr. Meyer Wiener, 308 N. 6th St., St. Louis.
Secretary: Dr. W. M. James, Metropolitan Bldg., St. Louis.
Place: Oscar Johnson Institute. Time: Clinical meeting 5:30 p. m., dinner and scientific meeting 6:30 p. m., fourth Friday of each month from October to April, inclusive, except December.

San Antonio Ophthalmolo-Oto-Laryngological Society

President: Dr. William D. Gill, 323 Medical Arts Bldg., San Antonio, Texas.
Secretary-Treasurer: Dr. Frank Steed, Nix Professional Bldg., San Antonio, Texas.
Place: Bexar County Medical Library. Time: 8 p. m., first Tuesday of each month from October to May.

San Francisco County Medical Society, Section on Eye, Ear, Nose and Throat

Chairman: Dr. Frank H. Rodin, 490 Post St., San Francisco.
Secretary: Dr. Louis F. Morrison, 490 Post St., San Francisco.
Place: Society's Building, 2180 Washington St., San Francisco.
Time: Fourth Tuesday of every month except May, June, July and December.

Shreveport Eye, Ear, Nose and Throat Society

President: Dr. John T. Crebbin, 624 Travis St., Shreveport, La.
Secretary-Treasurer: Dr. J. A. Wilkinson, Medical Arts Bldg., Shreveport, La.
Place: 1240 Texas Ave. Time: 7:30 p. m., first Monday of every month except July, August and September.

Spokane Academy of Ophthalmology and Oto-Laryngology

President: Dr. S. D. Brazeau, 407 Riverside Ave., Spokane, Wash.
Secretary: Dr. J. B. Stone, 1105 Paulsen Medical and Dental Bldg., Spokane, Wash.
Place: Paulsen Medical and Dental Library. Time: 8 p. m., fourth Tuesday of each month except June, July and August.

Syracuse Eye, Ear, Nose and Throat Society

President: Dr. Arnold B. Kauffman, 104 W. Onondaga St., Syracuse, N. Y.
Secretary-Treasurer: Dr. W. J. Werfelman Jr., 725 State Tower Bldg., Syracuse, N. Y.
Place: University Club. Time: Second Friday of each month except June, July and August.

Toronto Academy of Medicine, Section of Ophthalmology

Chairman: Dr. Samuel Mortimer Lyon, 122 Bloor St. W., Toronto.
Secretary: Dr. A. Lloyd Morgan, 86 Bloor St., West, Toronto.
Time: First Monday, November to April.

Washington, D. C., Ophthalmological Society

President: Dr. James M. Greear Jr., 1740 M St., N. W., Washington, D. C.
Secretary-Treasurer: Dr. Ernest Sheppard, 927 17th St., Washington, D. C.
Place: Episcopal Eye, Ear and Throat Hospital. Time: 8 p. m., first Monday in November, January, March and May.

ARCHIVES of OPHTHALMOLOGY

VOLUME 15 (old series Volume 72) JUNE 1936 NUMBER 6

COPYRIGHT, 1936, BY AMERICAN MEDICAL ASSOCIATION

PRIMARY TUBERCULOSIS OF THE CONJUNCTIVA

A. SAMUELSON, M.D.

STOCKHOLM, SWEDEN

Among the manifold symptoms and diseases caused by the tubercle bacillus, tuberculosis of the conjunctiva is rather uncommon. Tuberculosis of the conjunctiva as a primary condition, i. e., ulcer of the conjunctiva and swelling of the regional lymph nodes, which is the first manifestation of tuberculosis in an organism previously nontuberculous, is even more uncommon. Since 2 such cases have been studied at the ophthalmologic clinic of the Seraphimer Hospital during a period of less than a year, I consider them worthy of mention. During the last twenty years only 1 additional case has been recorded at the clinic.

The term primary, as used here, denotes that it is not possible with the aid of ordinary clincal methods of examination to prove that tuberculosis is present elsewhere in the body. But even if other foci of tuberculosis are found in such a case, it is not at all certain that the first alteration noted does not constitute a primary complex, provided the other tuberculous alterations can be proved to be of more recent date (Bergstrand [1]).

It has been maintained by some writers that in the majority of cases tuberculosis of the conjunctiva is a primary ectogenous infection (Igersheimer,[2] Leber), even in instances in which other tuberculous involvement is present. In the latter cases conjunctival tuberculosis would thus be a superinfection (Meisner [3]). Otherwise, it would be either endogenous, spreading via the vascular system, which many consider to be the most common manner (Lundsgaard [4]), or due to a spreading *per continuiatem*. One can thus differentiate between the two kinds of condition by the fact that the regional lymph nodes are swollen in a primary ectogenous infection but not in the other type

1. Bergstrand, H.: Nord. med. tidskr. **1**:182, 1929.

2. Igersheimer, J., in Schieck, F., and Brückner, A.: Kurzes Handbuch der Ophthalmologie, Berlin, Julius Springer, 1932, vol. 7, p. 86; Klin. Monatsbl. f. Augenh. **69**:226, 1922.

3. Meisner, W.: München. med. Wchnschr. **80**:677, 1933.

4. Lundsgaard, K. K. K.: Ztschr. f. Augenh. **47**:287, 1922; Acta ophth. **1**: 39, 1923.

of infection. Another means of deciding whether one is dealing with a primary infection should be afforded by repeated tuberculin tests, but there must be an opportunity of making the first test so soon after the beginning of the supposed infection that the body has not had time to become allergic. The length of this preallergic negative state varies as a result of many different factors, but generally this state lasts for from three to seven weeks. Unfortunately there is seldom an opportunity to make a tuberculin test during this time. Often the patient does not present himself for examination until the symptoms are far advanced, and by then an allergic condition has developed. Furthermore, the symptoms appear very slowly and in the beginning with no great discomfort to the patient. Although the infection most often is considered to arise in connection with trauma, no attention is paid to that, and generally the immediate results are not of a kind or of such importance that there is any reason to suspect tuberculosis at first. It is to be regretted that in none of the cases mentioned here was the condition diagnosed soon enough so that the tuberculin test gave a negative reaction.

Although primary tuberculosis of the conjunctiva is rare, it is far more common than was previously thought, the frequency differing greatly in individual countries. Virchow considered that tubercles never or very seldom occur on the conjunctiva. In 1874 Sattler described the first case of tuberculosis of the conjunctiva in which a clinical diagnosis was made. He also made a special classification of the symptoms typical of tuberculosis of the conjunctiva, describing four separate forms. Eyre has added a fifth symptom. Since then new cases have been occasionally reported, and during the last twenty years about 20 cases clearly indicated to be instances of primary tuberculosis of the conjunctiva have been described. In addition, Blegvad [5] in 1933 published an account of about 40 cases from the Finsen Institute in Copenhagen, among them being 4 cases in which cultures demonstrated the presence of tubercle bacilli of the bovine type. Further research has disclosed 7 additional cases, in all of which the infection was caused by bovine tubercle bacilli. In all of these cases the condition was considered to be of primary ectogenous origin. This strikingly frequent occurrence of tuberculosis of the conjunctiva Blegvad said is due to the prevalence of tuberculosis in cattle in Denmark. Probably there have been additional cases that have not been described, or they may have been referred to as cases of Parinaud's conjunctivitis or disregarded for other reasons.

A study of the cases described discloses the following facts: In a few cases the tuberculosis has been localized to the bulbar conjunctiva; in the rest, to the palpebral conjunctiva (from 70 to 80 per cent). The

5. Blegvad, O.: Acta ophth. **11**:345, 1933; Förh. nord. oftal. mötet Stockholm, ibid, to be published.

frequency of tuberculosis of the conjunctiva as compared with that of other ocular diseases has been estimated at greatly varying figures. According to Saemisch,[6] there are estimates varying from 1 in 1,300 (*Hagener Augenheilanstalt*) to 1 in 30,000 (Mules). According to another statement (Castresana), the number of cases varies from 1 in 3,000 to 1 in 33,000. At the ophthalmologic clinic of the Seraphimer Hospital during the period from 1915 to 1934, there were 7 cases of tuberculosis of the conjunctiva in a total of 181,000 cases, making a frequency of almost 1 in 26,000. However, of these 7 cases only 3 could be considered to be instances of primary infection, or about 1 case in 60,000. The incidence of primary tuberculosis of the conjunctiva as compared with tuberculosis elsewhere also has been estimated with considerable variation, ranging from 0 (Lundsgaard,[4] Junius) to 60 per cent (Villard) or 86 per cent (Grumet). The cases studied, approximately 20, indicated that the disease occurs nearly twice as often in women as in men, which is contrary to what was stated by Lafon but is in accordance with Saemisch's findings. The ages of the patients ranged from 6 months (Scroggie[7]) to 23 years (Holm,[8] La Ferla[9]). However, Avalos[10] reported the case of a patient who was 54 years old. All the rest of the patients were less than 20 years old. According to Lafon, 60 per cent of the patients have been less than 20 years of age. This age was formerly considered by some to be the highest limit for patients with tuberculosis of the conjunctiva (Lundsgaard), whereas others have considered the limit to be about 30 years (Eyre, Berro[11]).

In general, the disease has been characterized by ulcers, granulations or proliferations of the conjunctiva. One or more symptoms have always been at hand. It has been possible in only a few cases (one-fourth) to find tubercle bacilli in the conjunctival secretion, in the ulcer or in the excised tissue. In all cases a lymph node in front of the ear on the diseased side has been swollen, and in several cases the cervical lymph nodes also have been involved. Tubercle bacilli have been found in the lymph nodes (generally caseous) almost as often as in the conjunctiva. It is remarkable that preauricular lymphadenitis often is the first symptom noted by the patient.

---

6. Saemisch, T., in von Graefe, A., and Saemisch, E. T.: Handbuch der gesamten Augenheilkunde, ed. 2, Leipzig, Wilhelm Engelmann, 1901-1911, vol. 5, p. 484.

7. Scroggie, A.: Arch. chilenos de pediat. **4**:705, 1927; abstr., Zentralbl. f. d. ges. Ophth. **20**:138, 1928.

8. Holm, E.: Hospitalstid. **66**:2, 1923.

9. La Ferla, G. A., and Carbonaro, I.: Lettura oftal. **7**:117, 1930.

10. Avalos, E.: Rev. cubana de oto-neuro-oftal. **2**:129, 1933.

11. Berro, C. M.: Conf. Inst. clin pediat. Montevideo **3**:685, 1932; abstr., Zentralbl. f. d. ges. Ophth. **28**:670, 1932.

The tuberculin test showed a positive reaction in all the cases in which it was mentioned, except 1 (Coover [12]). That was the case of a girl aged 8 months who was in such poor condition that she died ten days after being admitted to the hospital. In the tissue from the conjunctival ulcer excised for examination both typical tubercles and tubercle bacilli were observed. Two cases are worthy of special mention in relation to the tuberculin test. The first (Scroggie) was that of a child 6 months of age who had had Koch-Weeks' conjunctivitis and who was infected by a woman with open pulmonary tuberculosis. Tuberculosis of the conjunctiva developed, with ulceration of the conjunctiva of the upper eyelid and swelling of the preauricular and, later, the cervical lymph nodes. The tuberculin test gave a negative reaction several times, and not until the eighteenth day after the appearance of conjunctivitis was the culture positive. A cure was effected. The other case (Vancea [13]) was that of a boy of 16 years in whom tuberculous alterations of the bulbar conjunctiva developed about a month after an injury to the conjunctiva. The tuberculin test did not show a positive reaction until after the lapse of a few months.

The cause of this type of conjunctivitis is the tubercle bacillus. Blegvad's investigations proved that of the various forms the bovine type is often the cause, and probably much more often than was hitherto suspected. As previously mentioned, this condition is ascribed to the prevalence of tuberculous cattle in the vicinity. The fact that the human type of tuberculosis gives rise to primary tuberculosis of the conjunctiva is proved by the cases to be reported here. The human type is less common than the bovine for the following reasons: For a person to become infected and to show symptoms of the disease a certain amount of the contagium must be introduced. Tuberculosis is generally a dirt-borne disease. Tuberculous patients are for the most part kept under the best possible hygienic conditions, so that the risk of their infecting others will be minimized. Tuberculous cattle, on the other hand, are usually not treated as a source of infection, and the persons in charge of them are thus intensively exposed to infection. A dairymaid, for instance, often leans her head against the cows while milking them several times daily and is thus in direct contact with the source of infection. If bovine tuberculosis were eradicated, tuberculosis of the conjunctiva also would disappear to a great extent.

With regard to the symptoms of the disease, reference should be made to textbooks and manuals.

---

12. Coover, D. H.: Am. J. Ophth. **3**:206, 1920.

13. Vancea, P.: Ann. di ottal. e clin. ocul. **60**:490, 1932; Cluj. med. **13**:205, 1932; Zentralbl. f. d. ges. Ophth. **27**:720, 1932.

The prognosis of this condition, which formerly was said to be very serious, is favorable since the introduction of the Finsen treatment. Many different methods of treatment have been suggested and have been claimed to result in cure, but the best method is that of Finsen. Often after only a few treatments, cure is obtained. In proportion to the spread of the process, however, there result larger or smaller scars in the conjunctiva, and these may cause shrinkage of the eyelids. The chief difficulty is encountered often in attempting to obtain healing of a fistula resulting from the abscessed lymph nodes. But fistulas too finally heal with the aid of Finsen treatments.

A few words as to the diagnosis of the disease will not be amiss here. Swelling of a preauricular lymph node, in many cases associated with fever, occurs in a great many diseases of the eye. Disregarding the more acute phlegmonous or especially virulent inflammations, those symptoms make a characteristic picture of a few rather rare diseases. As pointed out by different writers (Pascheff, Granström [14]), it might be called conjunctivitis with Parinaud's syndrome. Formerly a special disease of the eye showing these symptoms was called Parinaud's conjunctivitis with unknown etiology, but it has been found that this is not a disease with a uniform etiology but merely a group of diseases the etiology of which has not been discovered.

Among the diseases in which Parinaud's syndrome is observed, tuberculosis is the most common. Syphilis of the conjunctiva as a primary condition, is considered to be very uncommon; likewise, tularemia. Still rarer are the fungous diseases leptotrichosis and sporotrichosis of the conjunctiva. To make the diagnosis reliable several examinations must be made in each case. Microscopic examination of specimens excised from the diseased portion of the conjunctiva, preferably also from the preauricular lymph node, tests on guinea-pigs and serologic and cutaneous tests can aid in making a diagnosis. One should not be satisfied to note the change in the conjunctiva alone but should observe also that in the regional lymph nodes. In one case tubercle bacilli were present in the lymph node examined but not in the conjunctiva (Collevati [15]). Should the goal not be reached by these means, culture of material from the conjunctiva or the nodes may give information as to the nature of the disease.

The following cases of primary tuberculosis of the conjunctiva were studied at the ophthalmologic clinic of the Seraphimer Hospital.

CASE 1.—A boy aged 14 years was under treatment from October 1927 to March 1928. His mother had died of tuberculosis of the throat. Otherwise there

14. Granström, K. O.: Nord. med. tidskr. **7**:334, 1934.

15. Collevati, U.: Saggi di oftal. **5**:265, 1930; Zentralbl. f. d. ges. Ophth. **23**: 740, 1930.

was no known hereditary history or history of exposure to tuberculosis. The patient was healthy until about a month prior to his admission to the hospital, when he noticed a swelling in front of the left ear. This swelling was not painful. A few days later a similar swelling appeared under the left side of the jaw, and simultaneously a reddening and swelling of the left upper eyelid developed. The copious suppuration had slightly receded when the patient was first seen. There had not been any fever, and the boy had not been ill otherwise. There was no history of injury.

On admission there was a painless swelling of the lymph node in front of the left ear, the size of a walnut. A number of smaller swellings of the nodes in the left submaxillary triangle were noted. The left upper eyelid was red and swollen, especially temporally. The palpebral conjunctiva was reddened and rough and contained solitary granulations no larger than a pinhead. In addition, there was an abscess the size of a pea, with a grayish-yellow base. The lower lid was intact. There was severe suppuration. The bulbar conjunctiva was reddened and swollen, especially temporally. There were also numerous yellow nonconfluent granulations the size of a pinhead. The eye was otherwise normal. Vision was 0.4. The right eye was entirely normal.

Examination of specimens from the conjunctiva and from the margin of the abscess confirmed the clinical diagnosis of tuberculosis. Examination, including the making of two roentgenograms of the lungs, at an interval of six months, did not disclose any evidence pointing to the presence of pulmonary tuberculosis. Inoculation of guinea-pigs with material from the infected eye confirmed the diagnosis of tuberculosis. A tuberculin test was not made.

In addition to general invigorating treatment, the patient was given Finsen treatment for the infection of the conjunctiva. Healing was slow, and new granulations could still be seen in the conjunctiva after a few months. The patient was treated at intervals for more than two and one-half years, the last treatment being given in June 1930. He had then received a total of one hundred and seventy-two treatments, not all of them being given for the condition of the conjunctiva, however, the last ones being prophylactic because infection of the temporal canthus was suspected. The final result was complete cure, with a few temporal scars and accretions. This patient has been observed for seven years and is still in good health.

CASE 2.—A 10 year old boy was treated at the clinic from June to December 1934. There was no history of tuberculosis in the family, and the boy had not been exposed to the disease. He had been well until the appearance of the present condition. Five or six weeks before his admission to the clinic photophobia had started to develop, and there was suppuration of the left eye. A few days later he noticed a slightly painful swelling in front of the left ear and on the left side of the neck. He knew of no injury to the left eye.

On admission the lower left eyelid was slightly swollen, especially temporally, and there was a mucopurulent secretion. In the outer third of the conjunctiva of the lower lid an elongated ulcer was visible which was 2 or 3 mm. wide and 6 or 7 mm. long It began about 1 mm. from the margin of the lid and reached down to the inferior fornix. The edges of the ulcer were somewhat necrotic but not undermined and only slightly elevated. Closely surrounding the ulcer there appeared in the conjunctiva gray and grayish-yellow spots, in the shape of points and streaks, which were partly confluent with the meshwork. In the conjunctiva of the upper lid, close to the margin and near the medial line, was a grayish-white spot the size of a pinhead. The preauricular node was larger than a walnut, fairly soft and not painful. Below the left ear in the submaxillary triangle

was a collection of large, rather soft and somewhat painful lymph nodes. The eyeball and its conjunctiva were not involved. Vision was 1.

The right eye was normal, and vision was good.

Tests of the blood revealed no abnormality. In July the sedimentation rate of the blood was 55 and 89 mm. in one and in two hours, respectively; in March 1935, it was 12 and 46 mm., respectively. Tuberculin tests (0.1 mg., Mantoux) gave positive reactions on the same occasions. Twenty-four hours after the first

Fig. 1 (case 2).—Photographs showing the scars in the conjunctiva after treatment had been given and the fistula which developed in front of the left ear.

test there was an area of erythema measuring 25 by 30 mm.; after the second test the area was slightly larger, with a central papular formation, which was still present after six days.

Shortly after the patient was admitted to the hospital Finsen treatment of the conjunctiva and roentgen treatment of the lymphoma were started. After forty-five days the preauricular node began to disappear. Pus from this node when injected into guinea-pigs showed a positive reaction for tuberculosis. No determination of the type was made. The patient received a total of fifteen Finsen treatments.

After each treatment there was a very strong reaction, the eyelids were severely edematous, and the conjunctiva became red and swollen. Those symptoms, however, subsided in a few days. In December the process in the conjunctiva was healed, only a fine radiating scar remaining. In all other respects the conjunctiva was intact. The lower tarsal cartilage, however, was somewhat thickened and shrunken, so that the edge of the eyelid was slightly drawn down temporally. A large fistula remained in front of the left ear and was only a little smaller when the patient returned in March 1935. Three months later the fistula also was healed, with a large radiating scar.

After being under observation for a year the patient was in good health. Physical examination and repeated roentgen examination of the lungs and abdomen showed no evidence of tuberculosis.

CASE 3.—A woman 28 years of age was first treated in the clinic in November 1933. There was no family history of tuberculosis, and the patient had not been exposed to the disease. She had been well until the last of October 1933, when

Fig. 2 (case 3).—Photograph of the conjunctival lesion.

she observed a swelling, the size of a pea, in front of the left ear. About a week previously she had had an indefinite feeling of discomfort in the temporal region of the left eye, but she had not paid any attention to it. A fortnight later the swelling rapidly enlarged until it was about half the size of an egg. The patient knew of no injury to the eye.

On admission the eyelids were apparently normal. The conjunctiva of the left lid was slightly reddened. Inside the outer canthus far to the temporal side there was seen a small, disk-shaped, rounded protuberance, 3 or 4 mm. in diameter. In the center was a grayish-yellow, slightly depressed necrotic area. There was some reddening of the bulbar conjunctiva close to the outer angle of the eyelids. Aside from this the eyes were normal. Vision was 1.

To obtain a reliable diagnosis, the entire growth was excised. Microscopic examination showed the lesion to be typically tuberculous, with tubercles, necrosis on the surface and ulcerations. The tubercles, too, evinced numerous small necroses. Staining revealed a limited number of tubercle bacilli.

After twelve days the wound healed by first intention. At that time there were seen close to the scar in the conjunctiva three small, circular, grayish; gela-

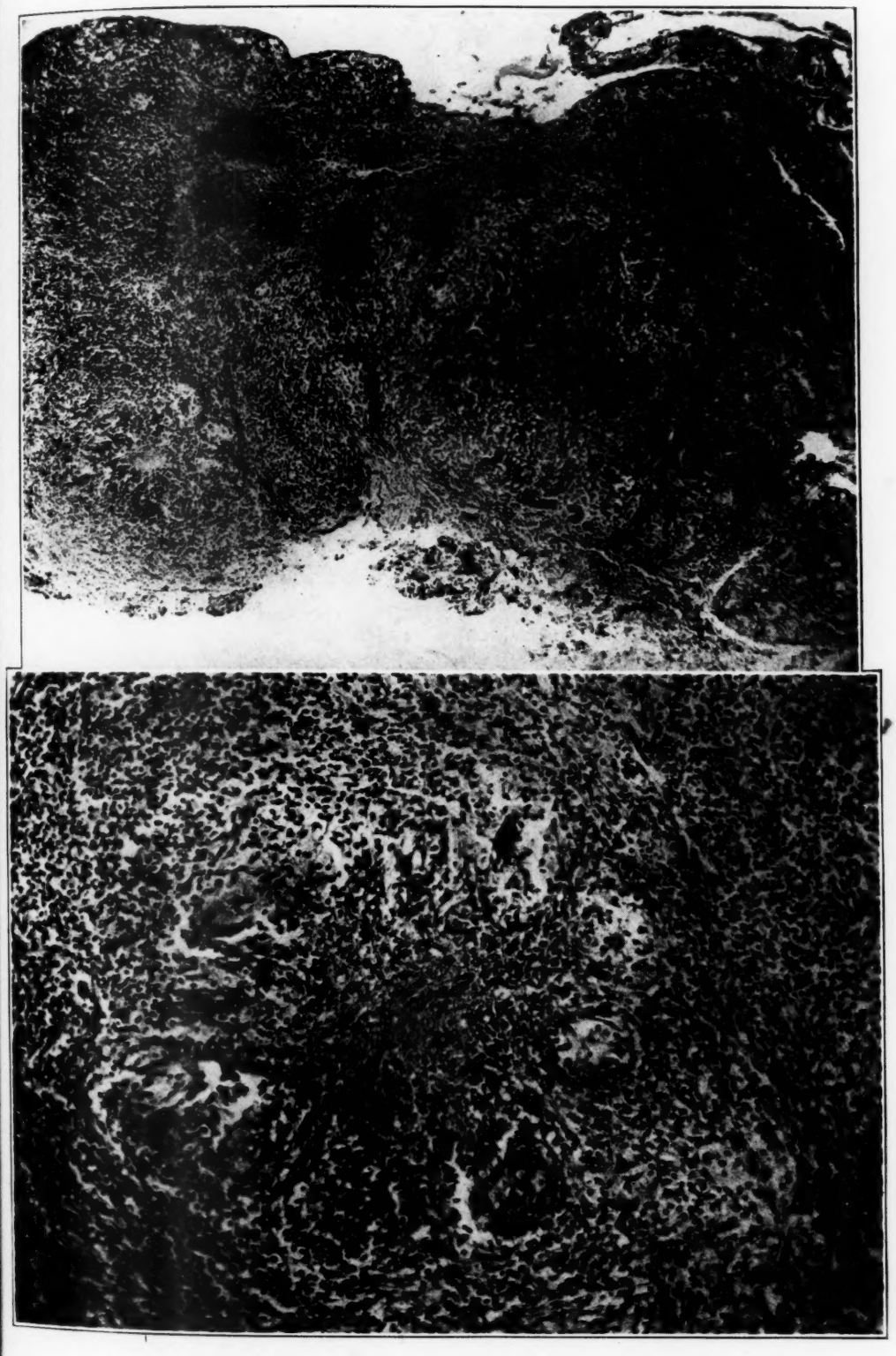


Fig. 3 (case 3).—Photomicrographs of sections of an excised granulation, showing typical giant cells.

tinous tubercles, the largest one more than 2 mm. in diameter. This clearly indicated that the process had spread to the surrounding tissue. The reaction to the Mantoux tests was positive (dose, 0.01 mg.), with a papular formation measuring 8 by 10 mm. The control test, eighteen months later, also showed a positive reaction, the papular formation measuring 10 by 10 mm. with the same dose.

The sedimentation rate of the blood at different times during the period of observation varied between 2 and 5 mm. per hour.

Finsen treatment was begun as soon as the diagnosis was determined. During the treatment new small granulations appeared on the under side of the upper lid, whereas they disappeared from the lower lid after seven treatments. The lesions of the upper lid did not disappear until after fifteen treatments had been given. Subsequent to each treatment there was an intensive reaction, marked by a swelling of the eyelids and of the conjunctiva and a slight increase in the amount of secretion. After six months the process in the conjunctiva was entirely healed, and the conjunctiva was smooth. However, it looked sinewy and glossy, slightly resembling a scar due to trachoma.

The swollen lymph node in front of the left ear steadily decreased in size. After four weeks it was the size of a kidney-bean. It was then carefully excised. Healing by first intention was obtained in six days without any evidence of a local or general reaction. Histologic examination disclosed tuberculous granulations with giant cells and necrosis and new granules resembling tubercles. Tubercle bacilli could not be found. The guinea-pig test was positive. Further examination established the fact that the bacilli were of the human type.

The patient has been under observation for two years, and repeated examination has not given any indication of tuberculosis in any other region.

SUMMARY

In the three cases here described the condition differed in no respect from the typical picture of primary tuberculosis of the conjunctiva. In case 3 the disease was caused by bacilli of the human type. It is regretted that there was no opportunity for continuing the examinations in the first 2 cases so that the type of bacillus could be determined. The third case shows that primary tuberculosis of the conjunctiva can be acquired at the end of the third decennium, as claimed by Eyre and Berro. There is, however, no reason why the age limit may not be still higher, though the possibility of infection becomes less and less for every year over 30. It is remarkable that in none of the cases was it possible to find the source of the infection, and no injury had been sustained prior to the outbreak of the disease. In all the cases Finsen treatment proved sufficient to cure the conjunctival condition, with the best possible cosmetic results. Other treatment of a general roborant nature and roentgen treatment of the lymphomas were of benefit. The prognosis also proved to be favorable from all points of view, contrary to what has previously been believed.

THE CILIARY MARGIN OF THE DILATOR MUSCLE OF THE PUPIL

WITH REFERENCE TO SOME MELANOMAS OF THE IRIS OF EPITHELIAL ORIGIN

BERTHA A. KLIEN, M.D.
CHICAGO

Not many years ago the nature and origin of the dilator muscle of the pupil were the subject of much speculation. Improvement of the methods of depigmentation and systematic investigation of embryonic development gradually brought to light its epithelial origin and its fine histologic structure.

As a basis for the further exposition of this subject I shall briefly review the established details of the embryology of the iris. The most anterior portion of the inner layer of the secondary optic vesicle becomes the pigment epithelium of the iris, the cells at the point of reflection being differentiated into the muscle cells of the sphincter iridis and the most anterior portion of the outer epithelial layer being transformed into the cells of the dilator muscle during the seventh month of fetal life. Some of the outer epithelial cells become separated from the continuous layer and preserve their epithelial character throughout life. They are the clump cells of the stroma of the iris (Elschnig and Lauber [1]). Nests of polygonal cells are frequently found between the dilator muscle and the pigment epithelium. They were first described by von Szily [2] and considered by him undifferentiated remnants of the outer epithelial layer. Von Szily also gave a clear description of the pupillary and ciliary margins of the dilator muscle.

The muscle cell of the dilatator pupillae, which consists of an inner, pigmented, spindle-shaped portion with a typical epithelial nucleus and an outer layer of contractile fibrils (Salzmann [3]), gradually changes in appearance toward the periphery. The fibrillary layer becomes thinner,

---

Read before the Chicago Ophthalmological Society, Nov. 18, 1935.

1. Elschnig and Lauber: Ueber die sogenannten Klumpenzellen der Iris, Arch. f. Ophth. **65**:428, 1906.

2. von Szily, A.: Beitrag zur Kenntnis der Anatomie und Entwicklungsgeschichte der hinteren Irisschichten, Arch. f. Ophth. **53**:459, 1902.

3. Salzmann, M.: Anatomy and Histology of the Human Eyeball, Vienna, Franz Deuticke, 1912, p. 140.

while the inner epithelial layer becomes more pronounced and higher until it gains the cubical shape typical of the outer pigmented cells of the ciliary epithelium.

While the transition of the inner layer of the dilator muscle into the pigmented ciliary epithelium is definitely recognizable in most meridional sections, it is difficult to observe the splitting up of the fibrillary portion. Some of the fibers take on an oblique and circular course, forming arcades, thus outlining the periphery of the lamella of the dilator muscle. Other fibers, remaining in the meridional plane, form radial bundles, which extend lateralward, backward or forward. The bundles that pass forward, which extend to the trabecula corneoscleralis, are of special clinical importance, as they play an important rôle in the action of the miotics in opening the angle of the anterior chamber. They were found to be especially well developed opposite the ciliary valleys and very delicate or absent in sections through the ciliary processes (Ewing [4]). Not always, however, does the periphery of the dilator muscle conform to this rather standardized description. Variations were first described by Grunert [5] as ciliary spurs and later mentioned by Elschnig and Lauber [1] among the slight malformations of the pigment epithelium, together with the spurs described by Fuchs [6] and Michel.[7] These variations are the subject of the following discussion.

In a total number of one hundred and sixteen eyes which were enucleated because of various conditions, the anterior segment was sufficiently well preserved to be suitable for these studies. Specially selected sections were depigmented and stained partly by iron hematoxylin combined with Van Gieson's stain and partly by Mallory's acid fuchsin or phosphotungstic acid stain.

There are two main variations from the aforementioned smooth transition of the epithelial portion of the dilator muscle into the outer ciliary epithelium. Both are characterized by an increased number of cells at the peripheral margin of the muscle.

In the first variation, elongated cells in varying amount are accumulated at the peripheral margin. Sometimes they are arranged in rows emphasizing one direction of the meridional fibrillation (fig. 1), or they may accompany all the fibrillary extensions (fig. 2); rarely, they

4. Ewing, A. E.: Ueber ein Bauverhältnis des Iris-Umfanges beim Menschen, Arch. f. Ophth. (pt. 3) **34**:1, 1888.

5. Grunert: Der Dilatator pupillae des Menschen, Arch. f. Augenh. **36**:319, 1898.

6. Fuchs, E.: Beiträge zur normalen Anatomie der menschlichen Iris, Arch. f. Ophth. (pt. 3) **31**:39, 1885.

7. Michel, J.: Ueber Iris und Iritis, Arch. f. Ophth. (pt. 2) **27**:171, 1881.

form thick, tumor-like plates (fig. 3). In the last instance the appearance of the cells varies considerably, owing to the fact that these elements have lost their exclusively meridional direction, and one obtains

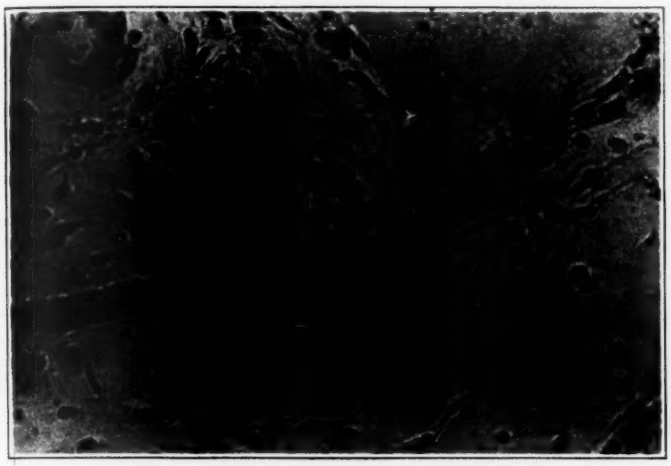


Fig. 1.—Smooth muscle cells connecting the dilator muscle with the trabecula corneoscleralis. *DM* indicates dilator muscle; *SM*, smooth muscle cells, and *TCS*, trabecula corneoscleralis.

Fig. 2.—Smooth muscle cells accompanying the meridional fibrillation. *DM* indicates dilator muscle; *PE*, pigment epithelium, and *CE*, ciliary epithelium.

views which are otherwise offered only in transverse or surface preparations.

These spindle cells have an oval nucleus and finely granular cytoplasmic pigmentation. The pigment is lying either throughout the cell

body or only in the perinuclear portion. Some of the cells end on each side with fine long fibrillae similar to those of the cells of the dilator muscle, but their fibrils remain in the axial direction of the cell instead of bending forward. The appearance of the nucleus, the fibrillation, the type of pigmentation and the staining properties of these spindle cells indicate their intimate relationship with the elements of the dilator muscle and characterize them as smooth muscle cells.

The occurrence of small groups or rows of these cells through a few serial sections is not extremely rare. They were observed in 13.7 per cent of the eyes examined. In one eye only they reached the dimensions of a small tumor, which was visible on both sides of the sections almost throughout the eye, with only slight variations in size from

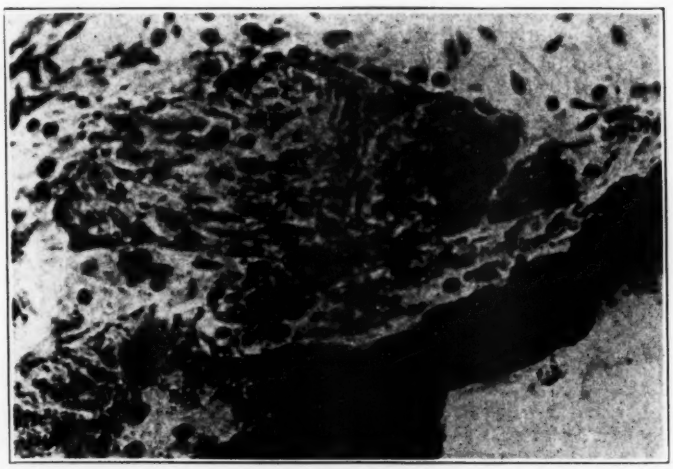


Fig. 3.—Small melanotic tumor composed mainly of smooth muscle cells. *DM* indicates dilator muscle, and *PE*, pigment epithelium.

0.4 to 0.7 mm., indicating almost complete tumefaction of the ciliary portion of the dilator muscle. Such malformations as have been described under this type of variation mean a reenforcement of the dilator muscle in one or more quadrants and may be responsible for irregularities of the pupil such as are observed sometimes after the administration of drugs.

A second and slightly more frequent variation at the ciliary margin of the dilator muscle consists of groups of deeply pigmented cells of epithelial character, usually in an alveolar arrangement (fig. 4). They are either connected with the dilator muscle by a few spindle cells or are lying free in the stroma of the iris. Only after depigmentation can the round or slightly oval eipthelial nucleus be recognized. While small

groups were noted in 18.1 per cent of the eyes, in only one eye did they form an arborescent tumor, which filled the space between the dilator muscle and the anterior surface of the iris, on the one hand, and the ciliary muscle and the trabecula corneoscleralis, on the other, reaching a

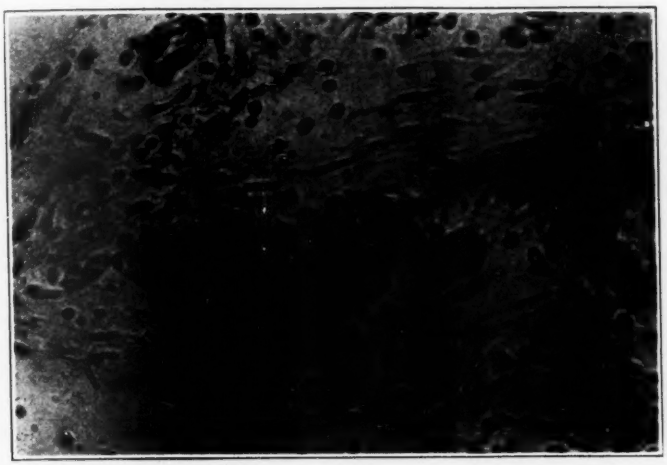


Fig. 4.—View of epithelial cells arranged in alveolar nests, after depigmentation. *DM* indicates dilator muscle, and *PE*, pigment epithelium.

Fig. 5.—Small melanotic tumor composed of epithelial cells in alveolar arrangement. *DM* indicates dilator muscle; *PE*, pigment epithelium, and *CE*, ciliary epithelium.

dimension of 0.5 by 1 mm. (fig. 5). There is no connection between the size of the eyeball and the occurrence of these malformations. Their nature did not suggest any connection with the age of the patient, and

this factor was found on investigation to be of no importance. There is no preference for any quadrant of the iris or any connection with the fetal cleft. They occur as often in light irides with little or no pigmentation of the stroma as in those with moderate or dense pigmentation of the stroma. Each of the two types of tumefactions usually contains a small number of cells of the other type and often contains groups of clump cells, so that a rather polymorphous appearance results. The present knowledge of the origin of the dilator muscle, the clump cells, the epithelial remnants of von Szily and, in part, of the sphincter muscle from the outer epithelial layers of the secondary optic vesicle shows that in the cells of the dilator muscle lie a number of dormant possibilities which may lead to malformations characterized by their polymorphous appearance. This is well illustrated by the small epithelial tumors described in this study.

In a general pathologic sense they would have to be classified as hamartomas, that is, excess anlagen, without further differentiation or with an abnormal differentiation of their element, usually without malignant tendencies. For practical purposes it will suffice to include them in the group of benign melanomas of the iris together with the benign tumors of the pigment epithelium and those accumulations of pigment cells on the surface of the iris which are commonly, but not very correctly, called pigmented nevi. In this connection I wish to present the histologic observations in a case of malignant melanoma of the iris, because of the similarity of parts of the tumor to the benign types of melanomas just described and the apparent connection with the dilator muscle.

REPORT OF CASE

A man 64 years of age entered the Cook County Hospital because of loss of vision of the right eye, of three months' duration, and pain and redness in the eye, of nine months' duration. Clinical examination of the eye revealed that the disturbance was due to a dark brown tumor of the nasal portion of the iris, which had obliterated most of the anterior chamber, had broken through the ciliary portion of the iris and extended inward also, so as to be visible through the nasal half of the pupil (fig. 6). The tumor was associated with a cataractous lens and secondary glaucoma, the intra-ocular tension being increased to 77 mm. of mercury (Schiötz). Microscopic examination revealed that the main tumor was located behind the nasal part of the iris, pressing it against the cornea and at one point causing its complete atrophy (fig. 7). This main mass, which was clinically visible through the iris and pupil, was shown after depigmentation to be almost completely necrotic except for a few superficial cellular layers and a triangular extension of the tumor backward on the ciliary processes. Tumor masses also infiltrated the anterior part of the ciliary body and the root of the iris on both sides in the fashion of a ring sarcoma (fig. 8). In the upper half there was a definite separation of the necrotic portion in the posterior chamber from these infiltrations near the root of the iris. Toward the lower half this

separation became less definite, and in the inferior nasal quadrant the increasingly massive infiltration of the iris and anterior part of the ciliary body had a direct connection with the main tumor. Here was the base of the tumor, which in this

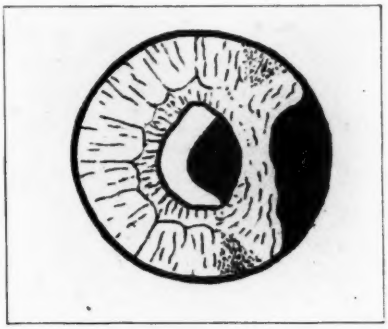


Fig. 6.—Clinical appearance of tumor of the iris.

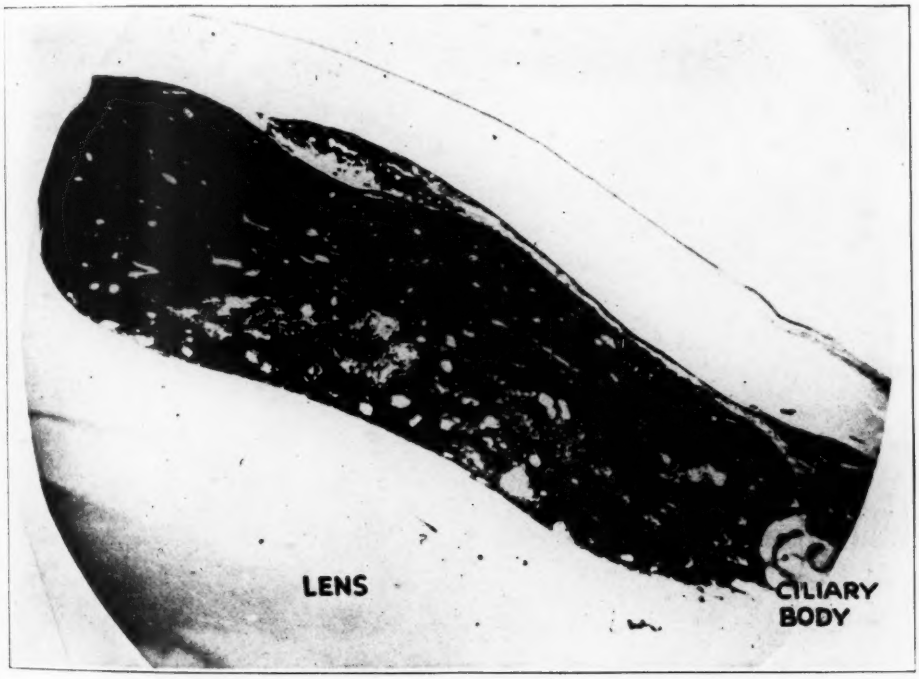


Fig. 7.—General view of malignant melanoma of the iris.

part had broken through into the posterior chamber, from which it was growing upward, backward and inward toward the pupil.

The cells composing the tumor were of two kinds: (1) spindle cells, most of which were deeply pigmented, with a small number only faintly pigmented or unpigmented, and (2) deeply pigmented epithelioid cells with the typical epi-

thelial nucleus. The nucleus of the spindle cells varied in shape from a slightly oval form, resembling that of the nucleus of an epithelial cell, to a more definite oval form with rounded or pointed poles.

The epithelioid cells of the tumor had an alveolar arrangement in many places, particularly in the neighborhood of the ciliary border of the dilator muscle. There appeared to be an intimate relationship between the masses at the root of the iris and the elements of the muscle. Many of these elements were enlarged; their number was increased, and they radiated into the tumor. On the temporal side the relationship of the tumor to the layers of the iris became more evident. There the pigment epithelium was completely intact. Close to it on the outside were groups of epithelioid and spindle cells, both deeply pigmented, which did

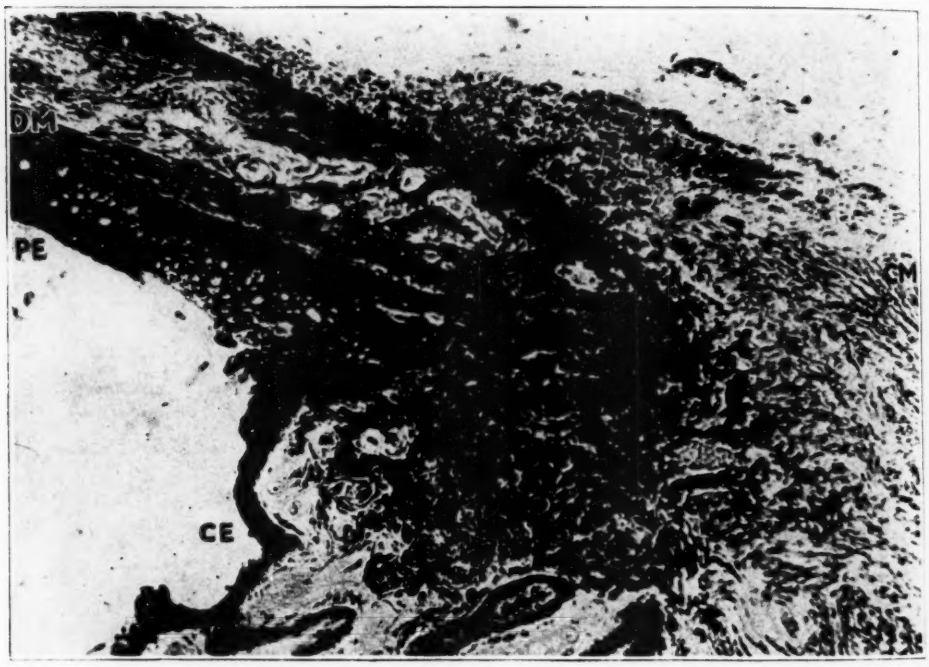


Fig. 8.—Arborescent tumor at the root of the iris in the superior nasal quadrant—the same tumor as shown in figures 6 and 7. *DM* indicates the dilator muscle; *PE*, pigment epithelium; *CE*, ciliary epithelium, and *CM*, smooth muscle cells.

not have a traceable connection either with the implantation masses of tumor at the angle of the anterior chamber or with metastatic foci which were numerous in other parts of the anterior segment.

Microscopic examination revealed that the tumor arose from the posterior layers of the iris but not from the pigment epithelium. By morphologic study, which was the only method of examination employed in this case, it was impossible to decide which was the matrix cell of the tumor, but the observations were suggestive of a derivate of the outer layer of the secondary optic vesicle, among which one has to consider the dilator muscle, the clump cells, the epithelial remnants of von Szily and the melanomas described in this study.

SUMMARY AND CONCLUSIONS

In addition to the benign melanomas of the surface of the iris, which are considered accumulations of the pigmented cells of the uveal stroma (E. Fuchs [8]), and the rare benign melanotic tumors arising from the pigment epithelium of the iris, there is another type of benign melanotic tumor of the iris of ectodermal origin. Tumors of this type arise from the outer epithelial layer of the secondary optic vesicle at or near the ciliary end of the dilator muscle and are characterized by polymorphy of the cells.

A similar origin may be taken into consideration for the malignant melanomas of the iris, which arise from its posterior surface and are also characterized by cellular polymorphy, perhaps including the so-called ring sarcomas.

8. Fuchs, E.: Naevus pigmentosus und Naevus vasculosus der Iris, Arch. f. Ophth. **86**:155, 1913.

CICATRICIAL ECTROPION AS A RESULT OF MUCOCELE OF THE FRONTAL SINUS

PLASTIC REPAIR

JOHN McLEOD, M.D.
AND
PAUL LUX, M.D.
KANSAS CITY, MO.

Ectropion as a result of mucocele of the frontal sinus appears from the absence of published reports to be an extremely rare condition. We have found no reports of cases after a fairly careful search of the literature, and the condition is not mentioned in any of the leading texts. That it is not so unusual as has just been indicated is evidenced by Lejeune's statement [1] that he has observed several cases of this disorder. However, the condition seems to be of sufficient rarity to justify this report.

REPORT OF A CASE

Mrs. R. H., aged 56, was first seen at the Alfred Benjamin Dispensary in September 1934. She gave a history of a large painless, noninflammatory swelling of the right upper lid, which began twelve years previously. About one year after the onset the upper lid had become so swollen as to interfere with vision, and relief was sought. The swelling was incised, and, according to the patient's statement, a large amount of whitish pus was obtained. The incision closed promptly, and the lid returned to its normal condition. The patient is certain that vision was good in both eyes at this time.

About three months later the site of the incision broke down, and a draining fistula became established. Attempts were made to close this, without success. The condition gradually became worse; the fistula enlarged, and the upper lid became everted, until in about one year after the establishment of the fistula the lid was in practically the same condition as on the patient's first visit to the dispensary. No treatment had been carried out for approximately ten years. The only point of interest in the past history was the presence of a chronic cough from the age of 20 until about the onset of the ocular condition.

Examination of the Eyes.—The right upper lid was completely everted, the margin disappearing into an opening about 5 by 3 mm. in the roof of the orbit just behind the orbital ridge near the nasal angle. The tarsal conjunctiva was greatly thickened and inflamed. The cornea, although exposed in its lower third, showed only a slight grayish infiltration and did not stain with fluorescein. There was a moderately profuse watery, purulent discharge. Ocular motility was normal except for a slight limitation of elevation. The lower canaliculis and the tear duct

---

Read before the Eye, Ear, Nose and Throat Section of the Kansas City Southwest Clinical Society, Oct. 10, 1935.

1. Personal communication to the authors.

were patent. Marked downward displacement of the right eye was noticeable (fig. 1). The pupillary reaction was normal. Ophthalmoscopic examination showed haziness of the entire lens, with stippled and irregular posterior subcapsular opacities. There were fine and large floating opacities in the vitreous. The disk was slightly pale; the fundus was generally normal.

The left eye was normal except for incipient nuclear cataract.

Vision in the right eye was 8/200; with a —1.75 cylinder, axis 80, it was 20/200. Vision in the left eye was 20/100; with a +1.25 sphere ⌒ +0.25 cylinder, axis 45, it was 20/30+.

A probe could be passed freely into the frontal sinus. Endoscopic examination showed the floor and walls of the sinus to be covered with hypertrophic mucosa.

Physical Examination.—The patient was slightly obese. Otherwise the results of physical examination were negative. A roentgenogram of the chest showed no abnormality.

Laboratory Examination.—The Wassermann and Kahn reactions of the blood were negative. The reaction to the Mantoux test with 0.001 mg. of tuberculin was negative; with 0.01 mg., ++, and with 0.1 mg., ++++. The urine, blood chemistry, blood count and sedimentation rate were normal.

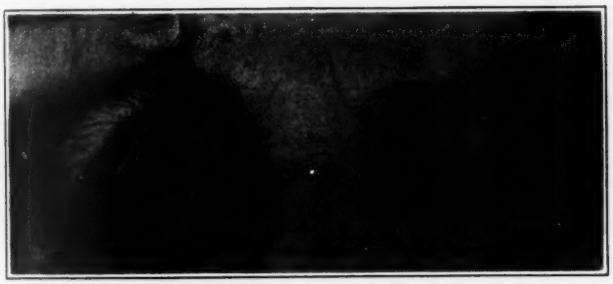


Fig. 1.—Photograph of the patient before operation on the sinus, showing downward displacement of the right eye.

A smear from the conjunctival secretion showed organisms morphologically identified as Micrococcus catarrhalis and Bacillus xerosis.

Direct smears from the frontal sinus showed the same organisms as in the conjunctival secretion, plus an acid-fast slender extracellular rod that occurred singly and in groups, strongly suggestive of the tubercle bacillus. The frontal sinus was washed with sterile saline solution, and the washings were cultured on Petroff's and Dorset's mediums directly and after treatment with sulfuric acid and injected into rabbits. No pathologic change was noted in the rabbits, and the only growth on the mediums was obtained from the untreated washings. This growth was a mixed culture. No pathogens were recognized, and therefore no further attempt was made at identification.

Microscopic examination of scrapings of tissue from the frontal sinus showed only chronic granulation tissue. Staining for acid-fast organisms gave negative results.

Roentgen Examination.—Roentgenograms showed increased density in the right frontal and ethmoid regions. The walls of the sinuses were distinctly thickened. In the frontal sinus there was a small area of decreased density suggestive of destruction of bone. The left antrum showed increased density.

Treatment and Results.—Preliminary treatment was instituted to clear up the discharge and reduce the swelling of the conjunctiva as much as possible.

On March 1, 1935, it was decided that an attempt should be made to obliterate the frontal sinus and also the fistulous tract. As a preliminary, an intranasal operation (Halle) on the frontal sinus was performed under local anesthesia. This was immediately followed by the external operation, which also was performed under local anesthesia. After the usual Killian incision the contents of the orbit were gently retracted, and the entire floor of the frontal sinus was removed. During this procedure it was found that the distal end of the fistulous tract was firmly attached to the floor of the frontal sinus. This attachment was carefully dissected out, and the fistulous tract was removed in toto. The anterior

Fig. 2.—Photograph of the patient four weeks after operation on the sinus.

Fig. 3.—*A*, photograph of the patient showing final result of operation after dissection of the scar tissue and transplantation of the graft. *B*, photograph showing final result of operation when the eyes are closed. There is incomplete closure of the right lid.

wall of the frontal sinus was not disturbed. A small drainage tube was inserted in the outer angle of the incision, and the wound was closed with silkworm gut sutures.

After completion of the nasal operation the upper lid was found to be intact but distorted. The skin which had been drawn into the sinus was flabby and purplish. The subcutaneous tissues were markedly thickened. The margin of the lid was everted on the lid and bound by scar tissue. In order to invert the lid completely it was necessary to remove a small V-shaped piece of the tarsus and margin of the lid and to remove a small amount of damaged skin. Enough scar tissue was dissected out to allow closure of the lids, which were sutured together

after the margins had been scarified in two places. Unfortunately, the lids did not unite, and the contraction of scar tissue secondary to the operation was perhaps more marked than might have been expected. Figure 2 shows the result four weeks after operation, when a drain was present in the frontal sinus. A celluloid shield had been used to protect the cornea. This produced a cutaneous irritation, which is visible on the cheek. It will be noted that the cornea was clear and that the hypophoria was less marked than in figure 1.

On April 23 most of the scar tissue was dissected out, and a large whole thickness graft was transplanted from the left upper eyelid, with the part under procaine hydrochloride anesthesia. Figures 3 and 4 show the final result. There was good function of the levator muscle, but enough scar was present to prevent complete closure. However, the cornea was protected and clear; there was no discharge from the eye, and the appearance of the patient was greatly improved. Vision was the same as before operation, but the myopia was somewhat less, and the vitreous opacities were clearing up.

COMMENT

The bacteriologic findings were rather striking, leading us at first to suspect sinusitis due to tuberculosis, an extremely rare condition. In the light of further study it was concluded that the acid-fast bacilli were undoubtedly secondary invaders, probably Bacillus smegmatis.

From the appearance of the patient in figure 4 it is apparent that a larger graft could have been transplanted without affecting the left upper lid. This might have produced slightly better closure of the right lid.

CYCLOPIA IN A NEW-BORN KITTEN: ANATOMIC FINDINGS

HARVEY D. LAMB, M.D.
ST. LOUIS

The term "cyclops," derived from the Greek κυκλος + ὤψ, meaning "round-eyed," is truly appropriate to the present specimen. As can be observed in figure 1, the relatively large eyeball is located in the midline, entirely external to the underlying cranium, and is not covered by eyelids.

Seefelder in 1930 reviewed the literature and briefly described the principal facts of cyclopia.[1] He stated that the condition strictly belongs to the malformations of the head, since the changes simultaneously involve the anterior part of the brain and the nose as well as the eye. Cyclopia is not an especially rare defect. Nor is it limited to man, for it occurs also in other mammals (most frequently in the pig) as well as in birds, amphibians and fishes. The anomaly particularly affects the part of the brain and of the skull lying between the two ocular anlagen and either partly or, exceptionally, entirely involves the ocular anlage itself. Consequently there always occur at the same time important malformations of the brain, particularly of the forebrain and of the midbrain, such as failure of the hemispheres to develop, absence or the unpaired occurrence of the olfactory nerve, abnormal formation of sulci, exencephalia and anencephalia. Consequently the fetus with cyclopia is generally not viable.

To explain the occurrence of cyclopia, two theories have now been in existence for over one hundred years. Meckel[2] in 1826 first advanced the opinion that a cyclops is produced by the joining together of the two primary, separate and distinct ocular anlagen. The second theory was published in 1832 by Huschke,[3] who stated that in the earliest stages of the development of the eyes of birds the ocular anlagen of the two sides are normally fused together for a brief period before separating into the two lateral rudiments, and that cyclopia is therefore due to the incomplete separation of the primarily fused ocular anlagen.

---

1. Seefelder, R., in Schieck, F., and Brückner, A.: Kurzes Handbuch der Ophthalmologie, 1930, vol. 1, p. 559.

2. Meckel, Johann Friedrich: Regarding the Coalescing Formations, Arch. f. Anat. u. Physiol. **1**:238, 1826.

3. Huschke, E.: The First Development of the Eye and Its Associated Cyclopia, Arch. f. Anat. u. Physiol. **6**:1, 1832.

Stockard [4] in 1909 reported that cyclopia occurred in a large percentage of embryos of teleosts (Fundulus heteroclitus) when they were allowed to develop in sea-water containing an excess of magnesium chloride. He thought that the magnesium exerted an inhibitory or anesthetic effect on the process of outpushing and separation of the optic vesicles, thus supporting the second theory.

Fischel [5] in 1921 denied that cyclopia as a rule takes place through a fusion of the previously separated ocular anlagen. According to this authority, the defect is due to an injury affecting the embryonal anlage in the earliest period of development, at the latest in the stage of gastrulation. Because of such damage, the differentiation of individual segmentation cells or of cells of earlier stages of development is restrained or directed into abnormal courses. According to the size of the defect, which is either confined to the affected part of the brain between the ocular anlagen or deeply involves the latter, there result the various stages of cyclopia. The repeatedly reported absence of the optic nerve in cyclopic eyes is thereby explained in the simplest manner conceivable.

GROSS OBSERVATIONS ON SPECIMENS

The present specimen was sent to me by Dr. W. W. Greulich, of the Yale University School of Medicine. The animal is a full term kitten; at least it is one of a litter the remainder of which are normal. It was born alive and lived for several hours. The mother separated it from the others and made no effort to care for it. The part of the animal available consists of the head and upper end of the trunk. The covering skin is furnished with dark-colored fur or hair about a centimeter in length. The projecting auricles are large and well developed and laterally limit a deep depression lined by mucous membrane. At the deepest part of the depression, in the midline, are two tiny round openings in the mucous membrane. No oral cavity or nasal processes are observed. The partly ossified vault of the cranium is apparently of normal expanse and curvature. However, when the top of the cranial vault is removed, the cranial cavity is found to be almost empty. No cerebral hemispheres, only the posterior part of the brain stem and the cerebellum are present. Anteriorly and inferiorly in the midline, there is observed a large roughly circular opening in the cranial vault, through which a small flat cord of tissue extends from the cyclops' eyeball.

The single eyeball, after fixation, measures 9 mm. anteroposteriorly and 11 mm. in the vertical and transverse axes, respectively. The

4. Stockard, Charles R.: The Development of Artificially Produced Cyclopean Fish, J. Exper. Zoöl. **6**:285, 1909.

5. Fischel, Alfred: The Normal and Abnormal Development of the Eye: The Manner and Position of the First Eye-Anlage, as Well as the Formal and Causal Origin of Cyclopia, Arch. f. Entwcklngsmech. d. Organ. **49**:383, 1921.

cornea is relatively large, being about 7 mm. in diameter. Lying superiorly, a short thick fold of skin proximal to the eyeball forms a very abbreviated upper eyelid.

The eyeball was excised from its underlying attachment to the cranium, embedded in paroxylin (celloidin) and sectioned horizontally.

MICROSCOPIC OBSERVATIONS

A thin stratified squamous cell epithelioma resembling that of the normal cornea lies on the cornea and sclera and covers all the exposed part of the eyeball. The cornea does not contain Bowman's membrane

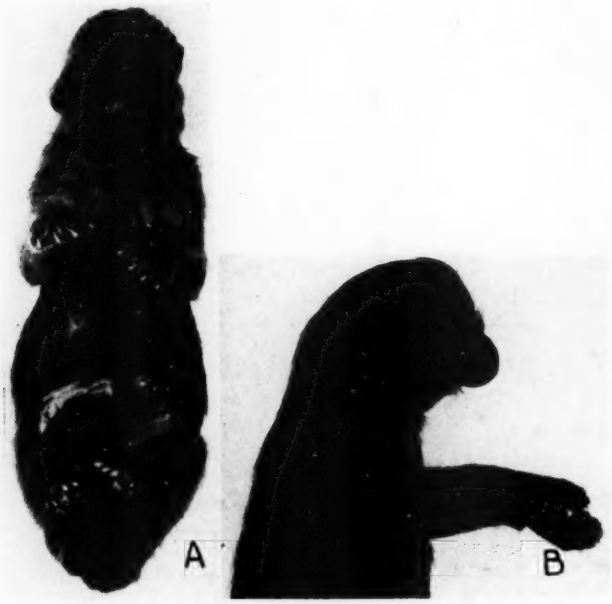


Fig. 1.—*A*, front appearance of the new-born kitten with a single median eyeball; *B*, side view of the cyclops.

but shows a posterior endothelium and Descemet's membrane, which is thin. A few capillaries lie between the anterior lamellae of the cornea propria. The sclera is highly vascularized, some of the anteriorly lying thin blood vessels being quite large. The iris is thin and narrow owing to its immature stage of development; the pigmented epithelial layers show fine cystic degeneration. Peripherally, the base of the iris has not as yet separated from the cornea to form the angle of the anterior chamber. The trabeculae of the filtration network are well differentiated. Although the ciliary processes show, the ciliary body is quite immature and consequently very shallow anteroposteriorly; in other words, the ora serrata of the retina lies considerably anterior as com-

pared with that of the fully developed eye. In neither the iris nor the ciliary body is melanin observed in the chromatophores. The lens, which is of normal composition, is surrounded by the vascularized tunic characteristic of this structure in the fetal stage, lying on the surface of the lens capsule.

The choroid is thick and contains many congested thin-walled blood vessels. The latter are closely grouped in the outer two thirds of the choroidal thickness. The inner third contains dense numbers of large elongated cells with large round or oval lightly stained nuclei. The long axes of these cells are arranged parallel to the inner surface of the choroid. These cells are those of the tapetum lucidum choroidale and compose the tapetum cellulosum of the carnivora. Scattered between these cells, small blood vessels, resembling capillaries, extend at approximately right angles to the surface of the choroid and join the choriocapillaris. Melanin is present in numerous chromatophores lying between the larger blood vessels in the outer two thirds of the choroidal thickness. The choroid is deficient or presents a coloboma in one small area posteriorly, and in its place lies the retina. At this site, the retina is adherent to the surrounding choroid, whereas in all other places the retina is artificially separated from the choroid.

As is normal, the retina internal to the tapetum contains no melanin in its epithelial layer. The retina proper presents large areas where the fetal arrangement of the cells is considerably disturbed by the presence of many large and small round, oval or tubular rosettes. These rosettes entirely resemble those observed in retinoblastoma. In the present eye, they are confined to the middle and external layers of the retina. They are also present in the retina occupying the coloboma of the choroid.

The optic nerve is not present nor is there any trace of an opening in the choroid or sclera.

Just behind the equator of the eyeball, the stratified squamous cell epithelium covering the sclera thickens and acquires keratohyaline granules and a horny layer resembling the epidermis. A subepidermal or connective tissue layer also appears and gradually thickens as it is followed posteriorly. The latter contains numerous small hair follicles and acini of sebaceous glands.

Posterior to where the skinlike covering of the eyeball begins, the sclera is split by an intervening thin layer of narrow voluntary muscle fibers. Posteriorly and centrally, whereas the inner scleral layer curves around to close the wall of the eyeball completely, the external scleral layer spreads backward and a little inward to line internally the skinlike covering of the eyeball. As a result, posteriorly and centrally, the diverging external layers of the sclera leave a wide space. The latter is filled by thick layers of narrow voluntary muscle fibers, lying generally peripherally and continuous with the anteriorly lying inner muscle

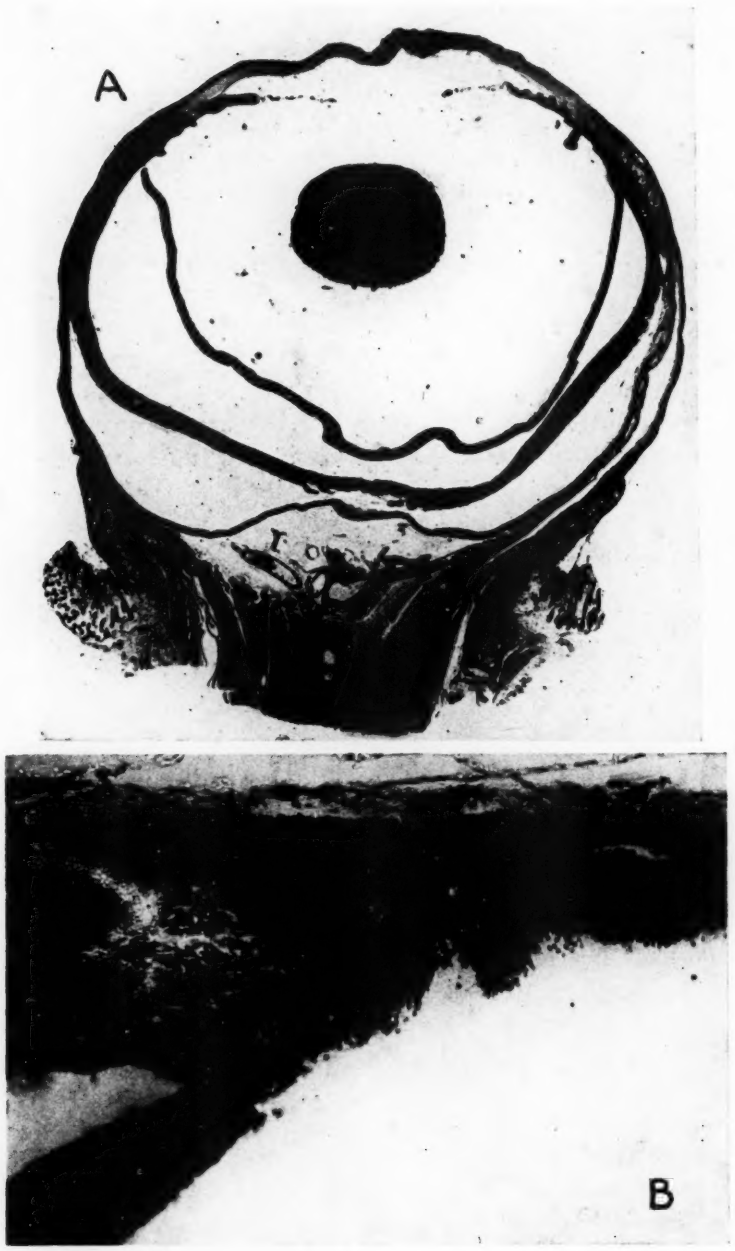


Fig. 2.—*A*, horizontal section through the eyeball of the cyclops at the level of the ciliary ganglion; *B*, section through one end of the choroidal coloboma, showing the end of the choroid to the left and above and the fetal retina containing rosettes filling in the coloboma.

layers splitting the sclera. Centrally between the muscle bundles lies a large mass of ganglion cells and nerve fibers, corresponding to the ciliary ganglion. From the latter extend anteriorly several small medullated nerves, accompanied by small capillaries, to enter obliquely the inner scleral layer, closing the eyeball posteriorly. Several large veins lie adjacent and just anterior to the nerve ganglion.

Jaensch [6] in 1926 discussed the presence of rosettes in the retina and concluded from the few times their presence (except in retinoblastoma) had been mentioned in the literature that they had been rarely observed. He concluded that these retinal rosettes indicate an early stage of retinoblastoma. This explanation appears to be too radical. Surely if these epithelial-like ependymal cells can form rosettes in the malignant ependymoma of the fourth ventricle and in the retinoblastoma of the eye they might, when displaced in the retina, form the same acinus-like structures as a kind of benign adenoma or even as isolated rosettes as in the case described by Jaensch.

SUMMARY AND COMMENT

Two principal kinds of changes are observed in this eye as compared with the normal adult eye. The most important are the changes associated with the cyclopia. With these are included the coloboma of the choroid and the formation of rosettes in the retina. The other type of changes are those due to the developmental retardation, simulating prenatal undevelopment.

No doubling or reduplication of any part of the eyeball is present. In other words, no separation of a single eyeball or coalescing of two eyeballs can be detected. It is very difficult to conceive of two ocular anlagen forming so complete a union as exists in this cyclopian eyeball. This singleness of all parts of the eye together with the lack of development of the brain and of the face impel one to favor the old theory of Huschke, more recently elaborated by Stockard and Fischel.

---

6. Jaensch, P. A.: The Formation of Folds and Rosettes in the Retina, Arch. f. Ophth. **116**:464, 1926.

DARK ADAPTATION AS A CLINICAL TEST

THE TECHNIC AND THE RESULTS

JACOB B. FELDMAN, M.D.
PHILADELPHIA

Dark adaptation is the increasing sensitivity of the eye to light in a totally dark room. It is a function of the choroid and of the bacillary layer of the retina. The smallest amount of light that is visible to the dark-adapted eye is called the "light minimum" (L. M.). Other terms used synonymously are "minimum light visible" (M. L. V.) and "light threshold" (L. T.). With light difference, which is a function of the conducting apparatus, this paper is not concerned.

In July 1934 I [1] described a self-registering instrument for taking the light threshold, and a dark adaptation graph was drawn charting this behavior of the eye with various periods of total darkness. The range of light necessary for the normal as well as for the moderately pathologic eye with a contracted pupil was found by trial and error to be between 0.000,001 millilambert (1 micromillilambert) and 0.13 millilambert (130,000 micromillilamberts). Therefore I made this the range of intensity of the apparatus. The instrument for taking the dark adaptation incorporates the seven variables described by Derby [2] and his collaborators, which should tend toward a standardization of results in the study of dark adaptation. In addition to being self-registering, the instrument is self-recording, easily manipulated in absolute darkness and noiseless; on one occasion, when a repair was found necessary, it was accomplished in the dark owing to the simplicity of the device.

A number of different types of patients, both normal and pathologic, were examined so as to be able to verify the findings of previous investigators and also to establish the accuracy of this apparatus. The dark adaptation records of each patient were kept in the form of a graph with the notation of the time in the dark in minutes (the abscissa) and the amount of light just perceived by the patient in photons (the ordinate).

From the Laboratory of Ophthalmology, Wills Hospital.

1. Feldman, J. B.: Instrument for Determining the Course of Dark Adaptation and for Measuring the Minimum Light Threshold, Arch. Ophth. **12**:81 (July) 1934.

2. Derby, G. S.; Chandler, P. A., and O'Brien, M. E.: Further Studies on the Light Sense in Early Glaucoma, Tr. Sect. Ophth., A. M. A., 1928, p. 37.

Besides the standardization of the instrument as to constancy of light, it was thought expedient to initiate also a uniformity of nomenclature and thereby make this clinical test more easily understandable. This was accomplished by avoiding the terms "low," "high," "retarded," "decreased" or "increased" when qualifying either the single threshold or the series of thresholds which constitutes the graph. Instead, the series of thresholds, that is, the graph, is qualified as being either normal or pathologic, and each of these types of graph is further qualified as high or low. The normal level of the graph is 0.000,010 photons; over 0.000,015 is the high normal. The pathologic graph begins at 0.000,020.

DETERMINATION OF THE SCALE OF ILLUMINATION

The results of determinations of the smallest amount of light just perceived (L.T.) have been given by the same or different writers in percentages, millilamberts, meter candles, fractions of a lambert and sometimes photons. A meter candle is a measure of the source of light; the lambert and its fractions the millilambert and micromillilambert are measures of reflected light, and the photon, the amount of light perceived by the retina. I have consistently used the term "photon." A photon is a unit of retinal illumination, and is the amount of light emitted by 1 candle per square meter per square millimeter of pupil. It was felt that since this was particularly an ophthalmologic observation notations should be made in photons, however uniformly the equivalent amounts in fractions of a lambert were recorded. This would facilitate comparison with the results of previous investigations. The photon unit which I used as calculated by Hecht [3] and his associates gives the factor for converting millilamberts into units of retinal illumination, viz.: millilamberts $\times \pi a/10 =$ photons in which a is the area of the pupil and π is 3.142. Since Judd [4] gives a photon factor somewhat higher, it is important to specify whose calculation for the photon is used.

METHOD OF PROCEDURE

The method of taking the dark adaptation reading was in each instance similar to the one used by Derby [5] and his co-workers.

1. A history was taken including the date, name, age, sex, vision, record number of the case, whether or not the patient had had an operation, and the results of studies of the blood if such studies had been made.

2. Three drops of 1 per cent of pilocarpine nitrate, one every fifteen minutes, were placed in each eye, augmented when necessary by one or two drops of 1 per cent physostigmine sulfate.

3. Three minutes of light adaptation before a 100 watt light enclosed in a lamp-house was allowed in each case unless otherwise stated.

---

3. Hecht, S.; Shlaer, S., and Verrijp, C. D.: Intermittent Stimulation by Light, J. Gen. Physiol. **17**:237 (Nov.) 1933.

4. Judd: Least Retinal Illumination by Spectral Light Required to Evoke the "Blue Arcs" of the Retina, Bureau of Standards J. Research **2**:447 (Feb.) 1929.

5. Derby, G. S.; Chandler, P. A., and Sloan, L. L.: A Portable Adaptometer, Tr. Am. Ophth. Soc. **28**:110, 1929.

4. A thirty minute or shorter graph of dark adaptation was taken with a light stimulus to the horizontal temporal side. Readings were made every thirty minutes. If desired the thirty minute test was repeated after a short interval of rest. On the second test, readings were begun after nine minutes of dark adaptation.

5. The taking of the dark adaptation was begun with a reading on one eye first; the next reading was done on the other eye, and so on, alternating every three minutes. This did not give one eye an advantage over the other.

6. The size of the pupil was measured.

7. The intra-ocular tension and the perimetric reading were taken if necessary.

By this method 1,007 eyes were investigated in patients between the ages of 9 and 82, whose conditions comprised normality, errors of refraction, glaucoma and various other pathologic states which will be reviewed. Studies were made at the office, the patient's home and the hospital to note the graphic results under various circumstances. The graphs were unaffected by location. From one to five tests were made in some cases. The periods of study varied from twelve minutes to four hours. And all the eyes were studied in absolute total darkness.

PREPARATION OF THE PUPIL

During the studies an attempt was made to use an artificial pupil, but this was found to be very impracticable and the results inaccurate. Other methods proved equally unreliable. It was therefore decided to use 1 per cent pilocarpine nitrate, one drop every fifteen minutes for three doses, and to take the contracted pupillary area multiplied by the photon factor for the amount of light perceived by the retina at the time of the examination. It is here necessary to note that the best results were obtained with the instrument when maximum contraction of the pupils was obtained; this made it necessary at times to augment the miosis by one or two instillations of 1 per cent physostigmine sulfate. No untoward effect was ever seen to follow this procedure. Recordings were attempted with full mydriasis from atropine, but owing to the enlarged pupil the minimum light of the apparatus was much too intense for a threshold reading with this instrument. Only by inserting extra neutral filters before the source of light could the minimum light of the apparatus be reduced so that the latter method could be used, which so complicated the technic as to make studies by the aid of pilocarpine and physostigmine the simpler method of procedure.

PRIOR LIGHT ADAPTATION

In an attempt to evaluate the preexposure to light before dark adaptation readings, studies were made in a number of cases with regard to the intensity of the light adaptation before beginning the readings of dark adaptation. Charpentier [6] had shown that various intensities of light adaptation will give a range of increasing sensitivity between 23 times, with moderate light, and 676 times, with full daylight. I [1] have tried adaptation to a 100 watt light encased in a hooded lamp-house held in front of the eyes, comparing it with daylight adaptation, and have found no appreciable difference in the dark adaptation readings. Thus I preferred the former because it was possible to have all the tests done without moving the patient from one room to another.

---

6. Charpentier: Sur les variations de la sensibilité lumineuse suivant l'étendue des partes rètiennes excitées, Compt. rend. Acad. d. sc. **91**:995, 1880.

By indirect methods Lohmann [7] calculated that two minutes is the exact time for an eye to become light-adapted. Various investigators have used periods ranging from two to ten minutes for light adaptation. Previous light adaptation is possibly not necessary if only one light threshold is persistently taken; however, the observer has then no definite way of determining whether the subject's result is dependable. When a graph of the dark adaptation is taken, the curve assumes the shape of a hyperbola, the irregularity of which may show either lack of attention or a pathologic condition. An investigation of this phenomenon will be reported on later. This adds an objective quality to a subjective test. When a graph is being taken the duration of the light adaptation definitely affects the readings, and it must be stated for each graph just how much light adaptation was used before dark adaptation was begun.

It can be said that the longer the preexposure the higher will be the initial threshold and the greater the curve to the graph. Chart 1 illustrates the value of previous light adaptation in studies of dark adaptation. The patient, F. R.,

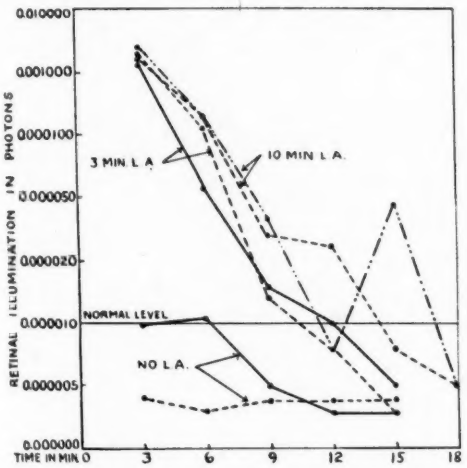


Chart 1.—Three graphs of the dark adaptation of patient F. R. with different periods of light adaptation. The solid line and the line of dots and dashes represents the dark adaptation of the right eye; the broken line that of the left eye. Observe the relation of the duration of light adaptation (*L.A.*) to the initial light threshold readings. The spaces between the ordinates were widely separated; otherwise the graphs for both eyes with no light adaptation would appear as a straight line (compare with other graphs).

had three tests made. To enable one to appreciate the activity of the graphs better, the ordinates are enlarged 5 times (compare the separation of the ordinates in this chart with those in chart 2). If this had not been done the graphs for the right and left eyes when no light adaptation was used would appear as a straight line. Compare this with the activity of the other graphs in the same chart corresponding to three and ten minute periods of prior light adaptation.

7. Lohmann, W.: Ueber Helladaptation, Ztschr. f. Psychol. u. Physiol. d. Sinnesorg. **41**:290, 1906.

THE FIXATION POINT

Although it is well known that after fifteen minutes of dark adaptation the cones and rods are equally sensitive, much time is saved from the start by having the subject fix the eye on a small red light on the instrument, which is of a wavelength nearer to 650 angstroms, to which only the cones are sensitive, and small enough to be seen by the rod-free area, as used by Hecht.[8] Lately I have adapted the modification suggested by Hay[9] in having the patient point to where the red dot should be. The patient fixes on his finger-nail, thus also using his muscle sense. This makes him feel partially responsible for the accuracy of the test.

THE SIZE, SHAPE AND POSITION OF THE LIGHT STIMULUS

A few experiments with the apparatus showed that the larger the area of the light stimulus the lower were the threshold readings, and thus it was arbitrarily decided to use a variable sector.[1] This could be moved in all meridians to include the various positions of rod sensitivity. It was found that the sensitivity of the retina was about equal throughout except for being slightly higher in the superior temporal plane. This was surprising, for it was felt that in a case of glaucoma in which this experiment was attempted the sector placed in such a position as to encompass the region responsible for the Rönne step, Seidel ring etc., should give a higher pathologic graph, whereas the graph showed no variation from the one in which the horizontal temporal region was studied.

DARK ADAPTATION READINGS

Graphs were taken on several subjects with readings at various intervals, and it was definitely found that the oftener the readings were made the lower the threshold. Thus a thirty minute graph for which readings are made at two minute intervals will give a lower threshold than one for which readings at three minute intervals and a still lower threshold than one for which readings are made at five minute intervals. Graphs were taken on normal persons as well as on patients with many forms of ocular and other pathologic conditions. In the cases of glaucoma graphs of dark adaptation were taken for the purpose of comparing this with the visual field and the tension as to their relative efficiency. It was felt that it was not necessary to choose a particular time (early morning hour) when the tension was highest. All tests were therefore done between 2 and 5 p. m., and in a few cases in which it was possible the tension and the visual fields were charted on the same day for comparison.

By the number of tests I have been able to verify a few of Downey's[10] observations: 1. Dark adaptation occurs in each eye independent of its fellow. 2. Dark adaptation proceeds equally in both eyes. 3. Full dark adaptation is easily overcome by exposure to light.

Jones[11] stated that from sixteen to twenty minutes is sufficient time for completing dark adaptation. Quite a few of my normal readings required only

---

8. Hecht, S.: The Nature of Foveal Dark Adaptation, J. Gen. Physiol. **4**: 116 (Sept.) 1921.

9. Hay, P. J.: Studies in Light Sense, Arch. Ophth. **39**:160, 1905.

10. Downey, J. W., Jr.: Minimum Light Sense and Retinal Dark Adaptation and a New Type of Photometer, Am. J. Ophth. **2**:13 (Jan.) 1919.

11. Jones, quoted by Lythgoe, R. J.: Illumination and Visual Capacities, Medical Research Council, Special Report Series, no. 104, London, His Majesty's Stationery Office, 1926, p. 23.

twelve minutes to go down to a normal level (chart 1). A great number of the pathologic graphs showed activity up to the thirty minute period. A thirty minute graph should be ample in the average case. Often at a certain time in the taking of a graph there is a minor loss of sensitivity of the eye to light. This I have called "rod suppression" or "rod fatigue." When there is definitely gross pathologic change, this suppression may be so high for a short period that the patient cannot perceive the highest amount of light which the apparatus may produce (1.3 millilamberts). When this occurs the graph is definitely pathologic, and this I have called "absolute rod suppression." However, it is best to continue with the study of the dark adaptation since the eye may regain its sensitivity to light before the completion of the interval of time for the graph. It has been found that when rod suppression occurs at the beginning and no sensitivity to light is obtained during the first nine minutes, there is little possibility of the patient having any sense of light at any time of the study of dark adaptation with this particular eye. This I have called "total absolute rod suppression."

When in the course of taking a graph there is a sudden high reading "rod suppression," it may often be of little consequence and may sometimes be due to inattention on the part of the patient (chart 1, uppermost graph at the fifteen minute reading). The proper procedure is to complete the study and then, after a few minutes' rest, repeat the entire study. If the condition is due to poor attention it will not show up in the second graph. Derby and his co-workers have correctly suggested that a second graph taken at some future date will greatly improve the results since the patient will have become familiar with the test. I have found, however that if the second graph is taken immediately after the first, it is almost axiomatic that a poor eye becomes worse through fatigue, and that a good eye becomes better by experience. Even when in the present study the pathologic graph was slightly better in the second taking, which only happened twice, this improvement was infinitesimal, and of course the light threshold never reached the normal. When it was desired to aggravate further the pathologic character of the readings for the first graph it was found best in the second test not to begin readings until after the ninth or twelfth minute of dark adaptation had elapsed. This often exaggerated the results of the first graph to a marked degree.

The big drop in the graph, i. e., the peak of increased sensitivity of the dark-adapted eye, was reached within from twelve to fifteen minutes usually, and in many cases it was not necessary to continue further with the study. Fifty-eight eyes of the group examined every two minutes showed a drop to normal in twelve minutes. In this group was a patient with glaucoma whose normal eye registered normal in twelve minutes while the glaucomatous eye showed, of course, a pathologic graph in that time. When a graph during a certain period in the readings has gone below 0.000.010 photon (normal level) it has always terminated normally, and while I have continued the studies on such graphs to the thirty minute period usually, the readings could have been terminated at an earlier period to expedite time. All interesting graphs were divided for study into two parts: (1) the tremendously increasing sensitivity of the first fifteen minutes and (2) the behavior after fifteen minutes to the ultimate threshold at thirty minutes.

RESULTS: NORMAL CONDITIONS

Chart 2 is representative of the normal graphs. Sixty-eight persons with normal eyes without refractive error were examined. The light

threshold was equal in both eyes in 16 of these subjects. On one of these patients a test was done with two minute readings, and at another time a second test was done on the same patient with readings every three minutes. In both tests the light threshold was equal in both eyes. Of the remaining 52 patients 22 had a very slightly higher threshold in the right eye and 30 in the left eye. A slightly higher threshold in one eye was obtained in 3 more females than males. The ages is this particular group varied from 10 to 68 years with no appreciable variation in the graphs. This concurs with the findings of Wölfflin.[12]

At this time it is also necessary to note that 5 patients with 4 plus Wassermann reactions gave normal dark adaptation graphs. In all cases examined it was found that when an eye gave a slightly higher threshold than its fellow, subsequent examinations disclosed the identical result. There was only one exception to this in the entire group examined.

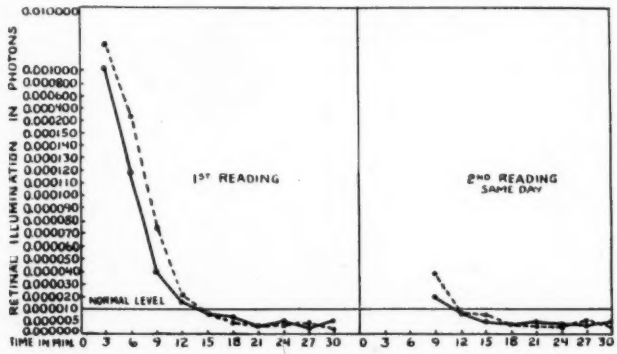


Chart 2.—Two graphs taken of the dark adaptation of a normal patient, O. B. The solid line represents the dark adaptation of the right eye; the broken line, that of the left eye. Note the consistency of the graph.

REFRACTIVE ERRORS BUT CONDITIONS OTHERWISE NORMAL

It was found that it was not necessary for the subject to wear the visual correction while the dark adaptation test was done. Persons with myopia as low as —20 D. sph. ⊃ —2.5 D. cyl. in each eye with a corrected vision of only 6/21 showed a normal light sense, which was equal in both eyes, as did also one with color blindness and with the same visual acuity of 6/21—observations verifying those of Tschermak and Raehlmann.[13] There were a few subjects with presbyopia who

12. Wölfflin, E.: Der Einfluss des Lebensalters auf den Lichtsinn Dunkeladaptierten Auge, Arch. f. Ophth. **61**:524, 1905.

13. Tschermak: Ergebn. d. Physiol. **1**:700, 1902. Raehlmann, E.: Ueber relativen und absoluten Mangel des Farbensinnes (partielle und totale Farbenblindheit), Ztschr. f. Augenh. **2**:315, 1899.

had a normal and equal light threshold. Also a patient with lateral nystagmus and a correction of —6.00 D. sph. ⌒ —5.00 D. cyl. on both eyes showed a normal light sense.

Of the 110 subjects with refractive errors, 44 showed a slightly higher light sense in the right eye, 37 in the left eye and 29 an equal light sense in both eyes. Five more females than males in this group showed a somewhat higher light sense in one eye. One patient with a nebular cornea had a slightly better light sense reading on the eye with the nebular cornea than on the other eye. A patient with an amblyopic eye had a slightly higher reading on the amblyopic than on the normal eye. The latter finding corroborates the observation that the light sense which the child is born with, while it is cruder than the form or color sense, is the protective sense and may be present even without normal vision. It was definitely seen that a disparity of the vision did not affect the resulting graph.

ARTERIOSCLEROSIS

Thirty-one patients with arteriosclerosis were examined. Their average age was 64. All showed pathologic graphs up to the twelve minute readings, except four whose graphs arrived at normal in thirty minutes. Three of these bear comment. On each of these three patients three graphs were taken at different times. One of these patients had had a normal graph. She then came on an occasion when she had marked arteriosclerotic symptoms, and the graph showed true pathologic variation clear up to the thirty minute reading. A second member of the arteriosclerotic group with normal graphs was a man of 40 who had, in addition to arteriosclerosis, papilledema with a large central scotoma in each eye. He also had an alternating divergent squint with an absolutely normal light sense. A third patient in this group had arteriosclerosis and a high systolic blood pressure which did not seem to affect the result materially.

CHOROIDITIS

Nine patients with choroiditis were examined. The oldest one was 69 years of age. The curve of dark adaptation of his right eye showed such pathologic change that it could not be recorded. He could not see the strongest light of the apparatus—"total absolute rod suppression." Another patient, aged 67 years, with a similar condition of the right eye also showed no graph reading. The left eyes of both these patients being normal, the graphs showed normal. Two patients aged 40 and 62, respectively, consecutively examined on several occasions showed constant pathologic readings on the affected eye. A patient aged 14 had two tests, and on each occasion the pathologic graph contained distinct

evidence of "rod suppression." Two patients showed pathologic graphs for both eyes, and two showed pathologic graphs for the eye affected while those for the fellow eye were normal. There were no patients with true macular choroiditis in this group, but it is probable that the results would have been the same.

GLAUCOMA

There were 109 patients with glaucoma (311 eyes). Some of these patients were examined from 2 to 5 times. The character of the dark adaptation graph bore some relation to the state of the visual field, little to that of the tension and none whatever to the acuity of vision except when the glaucoma was very severe, and then all four were affected. The graphs may be divided into the following four groups: (1) normal graphs, (2) pathologic graphs sometimes including "rod suppression" areas, (3) grossly pathologic graphs sometimes including "absolute rod suppression" and (4) graphs showing "total absolute rod suppression."

Group 1.—This group consists of unexplained normal graphs obtained on 8 patients with glaucoma:

Patient K—tension, right eye 25, left eye 23; by perimetry an enlarged blindspot noted in left eye; graphs on both eyes normal.

Patient L—tension, right eye 26, left eye 23; graphs, on right eye normal, left eye pathologic.

Patient Z—tension, right eye 18, left eye 18; enlarged blindspot in each eye; graphs, right eye normal, left eye pathologic.

Patient W—tension, left eye, 26; thrombosis of central vein; graph of left eye normal.

Patient B—tension, right eye 26, left eye 36; graphs normal.

Patient S—tension, right eye 34, left eye 26; graphs, right eye normal, left eye pathologic; left eye previously operated on for glaucoma.

Patient P—tension, right eye 26, left eye 26; graphs normal.

Patient K—tension, right eye 20, left eye 23; diagnosis, chronic glaucoma; graphs normal.

Group 2.—An example of this group is seen in chart 3. The threshold may fluctuate depending on the stage of glaucoma at the time of examination, but invariably the pathologic eye will show a pathologic graph. In chart 3 it is to be noted that the right eye is normal. The graph for the left eye does not descend quickly as does that for the right eye, but the threshold goes even higher up to fifteen minutes and then descends, never approaching normal. This is quite common to cases of glaucoma, although as yet I have not found any graph which can be shown as typifying a particular ocular condition. The second graph on the left eye taken the same day shows a higher threshold at the thirty minute termination than does the first one, and several "rod suppressions," one at eighteen minutes and one at twenty-four

minutes, indicating the increasing fatigue when a study of dark adaptation is immediately repeated. Compare chart 3 with chart 2, a normal graph.

Group 3.—The graphs in this group represent 50 patients, some of whom had tensions up to 60, 70 and even 101. There were 17 males and 33 females. The right eye was involved in 18 of the patients as against the left in 32.

Group 4.—This group comprised graphs on 22 patients. Of these, 20 were males and 2 were females. The right and left eyes were equally involved. It is interesting to note from the foregoing statement that while the grossly pathologic group 3 represents twice as many females as males, group 4, representing patients in whom the condition is more aggravated, shows the disease to be more insidious in the male, in the proportion of 10 to 1. In other words, in the small group studied

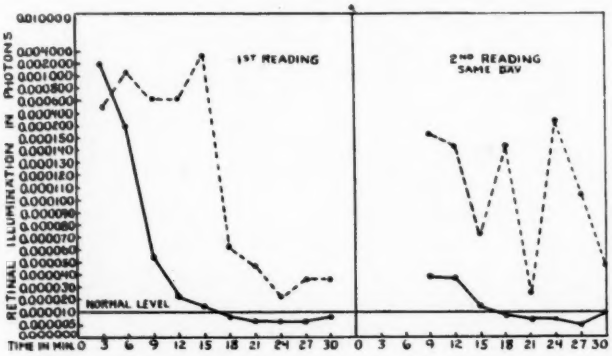

RETINAL ILLUMINATION IN PHOTONS
1ST READING
2ND READING SAME DAY
NORMAL LEVEL
TIME IN MIN.
0 3 6 9 12 15 18 21 24 27 30
0 3 6 9 12 15 18 21 24 27 30

Chart 3.—The right eye of the patient A. E. P was normal; the left eye, glaucomatous. The solid line represents the dark adaptation of the right eye; the broken line, that of the left eye. Observe the increasingly pathologic character and the rod suppression on the second reading.

women showed gross pathologic change most, and the men suffered the worst.

In an earlier portion of this paper several evidences were given among the graphs on normal persons of the consistency and sensitivity of the dark adaptation graph. These same traits were brought out in the following cases of glaucoma: Two patients with shallowness of the anterior chamber, play of colors before the eye and high hyperopia with normal tension showed low pathologic graphs; one had a normal visual field. Two other patients with unilateral glaucoma had the light stimulus in the studies of dark adaptation placed parallel to and a little below the superior temporal margin of the field of vision. As previously noted, the superior plane always gave a slightly higher threshold. These patients persistently showed, however, that the glaucomatous eye gave the higher pathologic graph.

Data Affecting Prognosis by Dark Adaptation Graph in Cases of Glaucoma.—An accurate dark adaptation graph cannot be obtained when one eye is very acutely inflamed, for the other eye, possibly owing to sympathetic involvement, may simulate a gross pathologic condition. The case of M. H. (chart 4) is one of this type. Jess [14] reported a similar case.

Graphs in group 4 give a guarded prognosis. A case in point is that of H. E.:

Right Eye	Left Eye
Tension 47	Tension 54
Total absolute rod suppression	Pathologic graph
Operation	Operation
Tension unimproved	Tension 20
Tension taken 7 months after operation, 64	
Eye very painful three days later	
Eye enucleated	To date no untoward effect

A case which shows definitely the value of prolonged dark adaptation as an aid in prognosis following immediately after operation is that of W. J. (chart 5). *A* of chart 5 shows several graphs of dark adaptation taken at various times on the left eye before operation. The tension in each eye was 35. This man was operated on on May 2, 1935. The visual field and the tension improved and a thirty minute graph (chart 5*B*) verified Zannetin's [15] observation that the graph will approach nearer to the normal after an operation for glaucoma. When, however, the graph was continued to one hour, it showed that rod suppression was setting in and gradually increasing after the first thirty minutes. I had not in any other case of glaucoma found a graph continued for one hour showing this marked ascending rod suppression, and therefore I felt in this case that the prognosis was very poor. Six months after operation the prognosis was verified; the visual field became contracted to approximately one half of its previous size, and the tension went up to 38 and 40 from 26. This is a simple test which can be done long before records of the tension or the field are available after an operation for glaucoma, and it may act as a gage in estimating the success of such an operation.

How Does Glaucoma Affect the Dark Adaptation Graph?—The Von Kries theory of the dual action of the rods and cones is too well

14. Jess: Ueber Adaptationstörungen auf sympathischem Wege sowie Demonstration von Gesichtsfeldern bei erworbener Hemeralopie, Ber. ü. d. Versamml. d. deutsch. ophth. Gesellsch., 1918, p. 217.

15. Zanettin, G.: The Central and Peripheral Light Sense in Chronic Simple Glaucoma, Ann. di ottal. e clin. ocul. **59**:847 (Sept.-Oct.) 1931.

known to require explanation. Percival [16] and others claimed that the increasing pressure of glaucoma exerted on the delicate rod structure definitely interferes with their function and therefore results in a higher pathologic light threshold. Of the rods and cones, the cones are the more delicate, and increased tension would inflict more destruction by

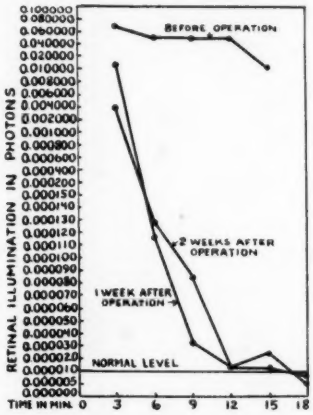

RETINAL ILLUMINATION IN PHOTONS
BEFORE OPERATION
2 WEEKS AFTER OPERATION
1 WEEK AFTER OPERATION
NORMAL LEVEL
TIME IN MIN. 0 3 6 9 12 15 18

Chart 4.—The uppermost graph was taken on the left eye of patient M. H. the day before operation for panophthalmitis of the right eye. Note the gross pathologic change at this time. The two graphs taken on the left eye after the operation are perfectly normal.

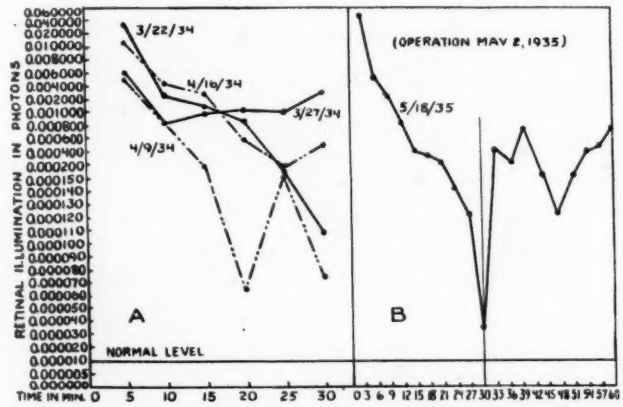


Chart 5.—*A*, four graphs taken at the dates given on the right eye of a patient with glaucoma, whose intra-ocular tension was constant at 35; *B*, graph taken after the patient was operated on. Note in *B* that the first thirty minutes of the graph shows improvement of the dark adaptation. After thirty minutes the graph shows rapidly increasing rod suppression.

16. Percival, A. S.: Notes on Light Sense, Tr. Ophth. Soc. U. Kingdom **42**: 285, 1922.

pressure on the form and color sense (cones) than on the light sense (rods). That the rods are quite resistant can be noted by comparing group 3, in which though some patients had very high tension graphs were obtainable, and group 4, in which though some patients had very much lower tension absolutely no graphs could be recorded. The only explanation, therefore, must be that in glaucoma, not the tension, but another factor which I cannot account for is the true cause affecting the photochemical sensitivity of the retinal structure. Group 1 represents a small minority of the total number of patients with glaucoma examined in which this factor has not contributed to the pathologic graphs of glaucoma. However, in view of these exceptional cases I should regard the dark adaptation test at present as one regards a Wassermann test. A pathologic graph like a positive Wassermann reaction is indicative of the presence of the disease, while a nonpathologic graph does not preclude the possibility that a pathologic condition is present. Study of the dark adaptation, like ophthalmoscopy, tonometry, perimetry and testing the visual acuity, is another method to aid in the early diagnosis of glaucoma.

LENTICULAR OPACITIES

Forty-three eyes with lenticular opacities were examined. The results were not satisfactory as to dark adaptation. Some showed normal, others pathologic, graphs. In many eyes the lenses were so dense that no view could be obtained to ascertain whether the lens was the only structure showing pathologic change. Others had definite glaucoma and other pathologic conditions accompanying the lenticular opacity and causing the pathologic graph.

RETINITIS

Six patients with retinitis who were submitted to several rechecks showed persistently pathologic graphs with two exceptions: One of the latter had vision of 6/12 in the right and of 6/9 in the left eye, while the blood pressure was 186 systolic and 104 diastolic. The other showed evidence that the light sense was approaching the normal, but only an eighteen minute graph was taken.

RETINITIS PIGMENTOSA

Four patients with retinitis pigmentosa had grossly pathologic graphs. One of these patients merits a short review. He was a boy of 11 with the history that his father and grandfather had the disease. The vision in both eyes was 6/6; the fundi and the visual fields were normal. The graph for the right eye showed gross pathologic change; that for the left eye, total absolute rod suppression. When this boy returned

for studies of the visual fields only very faint evidence of a disturbance of the fields was found in spite of the grossly pathologic dark adaptation graph.

OPACITY OF THE VITREOUS

Ten eyes showing opacity of the vitreous were examined, and all had pathologic graphs except one. The vitreous in these eyes was very dense and precluded examination of the fundus.

MISCELLANEOUS CONDITIONS

One patient with 3/60 vision and decided macular change in the right eye had two consecutive pathologic graphs for the eye involved and a normal one for the other eye.

Three patients with optic atrophy all showed normal graphs.

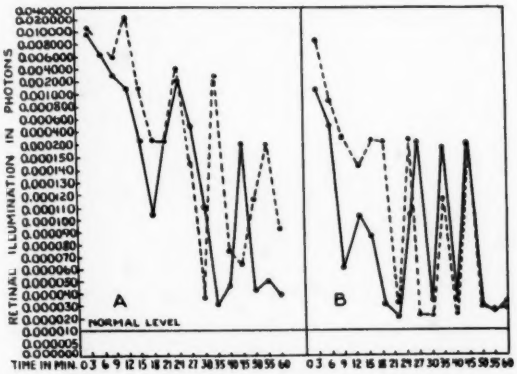


Chart 6.—Bizarre graphs: *A*, graph of the dark adaptation of a patient with Paget's disease (D. M.); *B*, graph of the dark adaptation of a patient with cerebrospinal syphilis (T. M.). The solid lines relate to the right eye; the broken lines to the left.

A patient with severe pansinusitis which two months later resulted in death showed pathologic graphs for both eyes.

A patient with low grade uveitis, a patient with encephalitis, a patient with complete ophthalmoplegia on one side and a neurologic patient whose condition was diagnosed as lenticular disturbance of familial origin showed normal graphs.

BIZARRE GRAPHS

Of the total number of patients examined, only 4 (8 eyes) showed bizarre graphs. Two of these patients had Paget's disease. The graph of one of the latter is illustrated in *A* of chart 6. One patient had arteriosclerosis with frequent attacks of cardiac asthma. One patient

had unequal pupils and a 4 + Wassermann reaction of the blood and spinal fluid (the diagnosis was cerebrospinal syphilis); the graph is reproduced in *B* of chart 6.

These graphs are difficult to explain; they bear a close resemblance to the chart of the visual fields of a hysterical patient. At least two of these patients were, however, very intelligent, really understood what was wanted and tried to cooperate as much as possible during the studies of their dark adaptation.

SUMMARY

A brief résumé of the original description of the instrument for measuring and recording dark adaptation is given. The necessity of a simple and uniform nomenclature is gone into. A method of procedure of both dark and light adaptation is given, and the justification for the steps taken is presented. An explanation of the graphs of both normal and diseased eyes is presented.

A review is made of 1,007 observations, which included both normal and abnormal conditions.

Attention is called to the different types of graphs associated with various ocular pathologic conditions, particularly glaucoma. An interpretation of the observations is attempted.

CONCLUSIONS

Dark adaptation is a sensitive test which shows consistency in its results. Ordinarily from twelve to thirty minutes is all that is necessary for the taking of a graph of dark adaptation. A single light sense threshold is not as reliable as a graph taken of a number of thresholds. The duration of the preexposure to light and the intensity of the light to which the eye is exposed before taking the graph of dark adaptation affects the course of the graph, as does also the frequency with which threshold readings are taken. A second test taken immediately after the first will verify a normal graph and usually will exaggerate a pathologic graph.

All graph studies are divided into (1) the behavior of the eye during the first twelve to fifteen minutes of the graph-taking period and (2) the behavior from then on to the termination of the period.

The presence of the pathologic light sense in patients with glaucoma is accounted for by some investigators as being caused by pressure exerted on the delicate retinal structures. If this were the case one would expect that the greater the tension the higher would be the pathologic graph. This, however, was not the case when groups 3 and 4 were compared. The absence of the pathologic graph in cases of glau-

coma was explained by Casten and Shaad [17] as being due to the fact that the observers employed only those portions of the retina which were normal. By means of the variable sector and accurate fixation, the entire retina was examined and found to show an equal sensitivity throughout, in health and in disease.

It is possible that there may be a chemical or biologic cause for the pathologic effect on the light sensitive rod structure. This would account for the normal graphs in the few exceptions in my group 1. However, in view of these few exceptions, for the present the dark adaptation graph, when pathologic, should be considered indicative of the presence of glaucoma in cases in which glaucoma is suspected, and a nonpathologic graph should be considered as not eliminating the disease. Dark adaptation is to be accepted as another laboratory test in the study of ocular disease. When the choroid and deeper retinal structure were affected the graphs were always definitely pathologic.

Different observers examining groups with the ocular diseases mentioned may obtain results differing from my findings, as my studies were made on nonselected cases. Further, some of my observations were made on complicated cases, the complication of which may have altered the true course of the graph. Thus, in many cases of lenticular opacities a pathologic graph was obtained when in truth I am of the opinion that the lenticular opacity per se does not affect the dark adaptation.

An attempt, if possible, will be made in the next group studied to limit the study to persons with pathologic conditions, in the hope of associating the various types of general and ocular disease to the types of graph.

Physicians Building.

Dr. A. Cowan and Dr. E. Spaeth of the Laboratory of Ophthalmology aided the study by rechecking certain cases of glaucoma that were investigated.

17. Casten, V., and Shaad, D. J.: Diagnostic Value of Tests of the Light Sense in Early Glaucoma, Arch. Ophth. **9**:52 (Jan.) 1933.

CHANGES IN REFRACTION FOLLOWING OPERATION FOR STRABISMUS

DON MARSHALL, M.D.
ANN ARBOR, MICH.

The importance in orthoptic training and in the care of all patients with strabismus of obtaining the best possible vision is obvious and well established. The only exception is the case in which the better eye is deliberately fogged in some way in order to stimulate improvement in vision in the amblyopic eye. Except when such training is purposely carried on, every care must be taken to insure the patient's possessing at all times his maximum of visual acuity. To this end, errors of refraction are carefully corrected, and properly fitted glasses become probably the most important single factor in the treatment of strabismus. That glasses often need changing after operations on the extra-ocular muscles for strabismus has received little emphasis by recent writers. In fact, in most texts and articles dealing with changes in refraction only bare mention has been made of the possible effect that surgical intervention may have on the refractive state and therefore on the visual acuity of eyes on which an operation for squint has been performed.

A brief outline of a case will show what can occur in this regard.

A girl aged 10 years had alternating convergent strabismus of 27 degrees but normal vision in each eye. Recession of the left internal rectus muscle was performed, the eyes being straight with correction thereafter. Eight months before operation, when cycloplegia had been induced by atropine, vision in the right eye was 6/6 —2 with +2.00 sph. ⌒ +0.75 cyl., axis 45°. Vision in the left eye was 6/6 —2 with +2.00 sph. ⌒ +0.25 cyl., axis 165°. Two days before operation vision in the right eye was 6/6 with +1.75 sph. ⌒ +1.00 cyl., axis 60°. Vision in the left eye was 6/6 with +2.00 sph. ⌒ +0.25 cyl., axis 40°. These slight changes showed that the eyes were not undergoing significant spontaneous change.

One week after operation vision in the right eye was 6/4.5 —3 with +1.75 sph. ⌒ +1.00 cyl., axis 60°. Vision in the left eye was 6/6 with +0.75 sph. ⌒ +2.00 cyl., axis 75°.

Four months after operation vision in the right eye was 6/4.5 —3 with +2.25 sph. ⌒ +0.37 cyl., axis 72.5°. Vision in the left eye was 6/4.5 —2 with +2.25 sph. ⌒ +0.50 cyl., axis 67.5°.

From the Department of Ophthalmic Surgery, the University of Michigan.

Read before the American Academy of Ophthalmology and Otolaryngology, Cincinnati, Sept. 18, 1935.

A study completed under the John E. Weeks Scholarship for Research in Ophthalmology, the University of Michigan.

Eleven months after operation vision in the right eye was 6/4.5 —3 with +2.25 sph. ⌒ +0.50 cyl., axis 70°. Vision in the left eye was 6/4.5 —2 with +2.00 sph. ⌒ +0.75 cyl., axis 65°.

If, as Lloyd [1] has stated, the greatest contribution one can make toward binocular vision is to bring the vision of the poorer eye as nearly to 20/20 as possible, and if the refraction of an eye changes greatly during the week after an operation for strabismus, it is plain that lenses prescribed for that eye preoperatively may be a gross misfit afterward and that the patient may be considerably handicapped in his efforts to obtain stereoscopic vision.

The original assumption that astigmatism is congenitally acquired and is fixed throughout life was early proved erroneous. Astigmatism may change at any period of life, but in normal eyes these variations are due to changes in the lens, since corneal astigmatism changes little at any age.[2] Abnormally, astigmatism may be caused or changed by corneal section; [3] keratoconus; [3] a tumor of the lids, such as chalazion,[4] or of the orbit; a trephine operation; [5] trauma; [6] a tumor or disease of the cornea, such as pterygium or scars; irregularities in the lens or posterior tunics of the eye; diabetes, and disease of the ciliary body. It has long been felt that traction by the lids and their pressure on the globe cause astigmatism, even to the point of explaining the usual change from so-called direct astigmatism in youth to inverse astigmatism in old age, due to senile loss of tone of the lids.

In 1874 Noyes [7] reported an increase of astigmatism with rather marked changes in refraction following tenotomy of the internal rectus muscles for esophoria. In 1903 Bull [8] reported the disappearance of —1.75 diopters, axis 90°, of astigmatism three days after tenotomy of an external rectus muscle for exophoria. Both these writers stated

1. Lloyd, R. I.: The Etiology of Strabismus, Arch. Ophth. **7**:934 (June) 1932.

2. Jackson, Edward: (*a*) Changes in Ocular Refraction, Bull. Am. Coll. Surgeons **16**:50 (Dec.) 1932; (*b*) Common Changes in Regular Astigmia and Their Causes, Tr. Sect. Ophth., A. M. A., 1918, p. 89.

3. Jackson, Edward: Changes in Astigmatism, Am. J. Ophth. **16**:967 (Nov.) 1933.

4. Reese, W. S.: Refraction Change Due to Chalazion, Pennsylvania M. J. **32**:764 (Aug.) 1929. Campbell, J. A.: Unusual and Sometimes Overlooked Causes for Refractive Anomalies, J. Ophth., Otol. & Laryng. **27**:112, 1923.

5. Zentmayer, W.: Sclerocorneal Trephining in Chronic Simple Glaucoma, Am. J. Ophth. **14**:617 (July) 1931. Smith, J. W.: Progressive Refraction Changes Following Trephine Operation, Arch. Ophth. **9**:259 (Feb.) 1933.

6. Huber, O.: Refraktionsverminderung durch Trauma, Klin. Monatsbl. f. Augenh. **88**:230 (Feb.) 1932.

7. Noyes, H. D.: Astigmatism Produced by Tenotomy of Recti Muscles, Tr. Am. Ophth. Soc. **2**:128, 1874.

8. Bull, G. J.: An Astigmatism Cured by Operation, New York M. J. **77**:221 (Feb. 7) 1903.

as their opinion that the changes in refraction were due to the changes in the muscles. As a result of these articles, A. E. Davis [9] in 1903 warned against tenotomy or any operative procedure primarily for the treatment of astigmatism. Surgical treatment of astigmatism, chiefly by corneal section or cautery, apparently was somewhat in vogue at that time.[10] Davis [9] stated that most oculists would agree that the rectus muscles exert pressure on the globe, saying: "most of us have had the sad experience of seeing vitreous squeezed out of an eye during a cataract operation by traction of the straight muscles on the eyeball, the lids being held entirely free from the eye." Davis [11] referred again to his case of a house surgeon at the Manhattan Eye and Ear Hospital who could voluntarily, with lids held away from his eye, increase the corneal astigmatism by 1.5 diopters in the right eye and by 1 diopter in the left eye and could nearly equal this after the instillation of scopolamine. Without question this increase in astigmatism, as shown by the keratometer, was caused by the rectus muscles.

That was in 1903. Today, although tenotomy is less frequently performed, operations for strabismus are becoming more and more frequent, while the effect of these on errors of refraction seems to be almost forgotten. Perhaps this reticence is to avoid an implied connection with the school of the late Dr. Bates,[12] who enlarged on this subject to a ridiculous extreme. Ball [13] and Duke-Elder [14] have mentioned that tenotomy of a rectus muscle may alter the corneal curvature. In the "American Encyclopedia and Dictionary of Ophthalmology" also this fact is mentioned, the section having been written by Davis.[15] Posey,[16] Jackson,[17] Clark,[18] Ellett [19] and Fuchs [20] have not mentioned it.

---

9. Davis, A. E.: A Consideration of the Operative Methods for the Cure of Astigmatism, New York M. J. **77**:1016 (June 6) 1903.

10. Breuer, A.: On the Operative Treatment of Corneal Astigmatism, Lancet **1**:1529, 1901.

11. Davis, A. E.: Accommodation in the Lensless Eye, Manhattan Eye and Ear Hosp. Rep. **2**:41 (Jan.) 1895.

12. Bates, W. H.: A Study of Images Reflected from the Cornea, Iris, Lens and Sclera, New York M. J. **107**:916 (May 18) 1918.

13. Ball, J. M.: Modern Ophthalmology, Philadelphia, F. A. Davis Company, 1927, vol. 2, p. 1224.

14. Duke-Elder, W. S.: The Practice of Refraction, ed. 2, Philadelphia, P. Blakiston's Son & Co., 1935, p. 113.

15. Davis, A. E., in Wood, C. A.: American Encyclopedia and Dictionary of Ophthalmology, Chicago, The Cleveland Press, 1919, vol. 14, p. 10943.

16. Posey, W. C.: Some Extraneous Factors Bearing upon Refraction, Am. J. Ophth. **7**:270, 1924.

17. Jackson, Edward: Changes in Refraction of the Eye, Tr. Am. Acad. Ophth. **33**:26, 1928. Footnotes 2a and 3.

(Footnotes continued on next page)

But twenty years ago Howe [21] expressed his conviction that the extraocular muscles affect the form of the globe and showed incidentally that the internal rectus muscle has a lifting power of 14 Gm.; and thirty-six years ago Norris and Oliver [22] specified "contraction of the exterior ocular muscle groupings" as a cause of astigmatism.

METHOD

To discover and establish the occurrence of changes in refraction consequent on operations on muscles for strabismus, a series of cases was studied. There were fifty-five patients, on whom a total of sixty-two operations were performed for the correction of squint. A total of eighty-eight muscles were operated on, since often two or more muscles were dealt with at one time. The group was selected by excluding all patients with poor vision or poor fixation in either eye and all patients who were unreliable at refraction. No selection was made as to sex, age, type or degree of squint or type of operation. Refraction after the instillation of a cycloplegic was carried out before operation, again at the time of the patient's discharge from the hospital and in a large share of the cases again at later intervals. The cycloplegic consisted of a 1 per cent solution of atropine sulfate instilled three times daily for three days for children of 14 years or less and a combination of a 3.5 per cent solution of homatropine hydrobromide and a 0.5 per cent solution of cocaine hydrochloride instilled every ten minutes for six doses for patients over 14. A large majority of the refractions were performed by the same examiner. All the patients were given a retinoscopic examination, and then a subjective check was made.

The ages of the fifty-five patients ranged from 5 to 31 years, averaging 12.3 years. The types of squint represented were: convergent, 83.5 per cent of the cases (in 43.6 per cent, alternating); divergent, 14.5 per cent; right hypertropia, 1.8 per cent. The right eye alone was operated on in 38.7 per cent of cases; the left eye, in 48.4 per cent, and both eyes, in 12.9 per cent. In nine cases in the right eye and also in the left eye, two muscles were operated on at the same time. The operations performed were as follows: recession, 50 per cent; resection, 35 per cent; tenotomy, 8 per cent; tuck operation, 5 per cent; resection with advancement, 2 per cent. At least several months before 40 per cent of the sixty-two operations refraction had been carried out and thus provided a check on any marked changes in the refraction which might have been occurring spontaneously. The average time of the refraction was nineteen and five-tenths months before operation. In slightly over half of these patients the eyes showed no difference of over 0.25 diopter in either vertical or horizontal meridians between this early refraction and that performed immediately before operation. Of the remaining patients, 45 per cent showed a change in one meridian of only 0.25 diopter and 23 per cent a change of only 0.5 diopter. The remaining small per-

18. Clark, C. F.: Changes in Refraction, Arch. Ophth. **56**:52 (Jan.) 1927.

19. Ellett, E. C.: Refractive Changes, J. A. M. A. **87**:1453 (Oct. 30) 1926.

20. Fuchs, E.: Textbook of Ophthalmology, ed. 5, Philadelphia, J. B. Lippincott Company, 1917, p. 898.

21. Howe, L.: The Muscles of the Eye, New York, G. P. Putnam's Sons, 1908, vol. 2, p. 120.

22. Norris, W. F., and Oliver, C. A.: System of Diseases of the Eye, New York, J. B. Lippincott Company, 1899, vol. 4, p. 429.

centage showed greater changes, but the early refraction indicated that in general the eyes of those patients were not undergoing any marked spontaneous refractive change.

Basic refraction, from which subsequent changes were calculated, was determined four days or less before the day of operation for 77 per cent of the patients and less than three months before operation for 94 per cent. The degree of squint preoperatively averaged 25 degrees. For 94 per cent of the patients the first postoperative refraction was made fourteen days or less after the day of operation. The average vision of all the eyes was better than 6/6.

Changes in the refractive state are reported here as changes in the vertical and horizontal meridians of the eye, the latter being considered as a refracting unit. For example, an increase in the convex sphere discovered at the time of refraction is here noted as a decrease in the curvature of both the vertical and the horizontal meridian of the globe of an equal degree in the two planes. A decrease in the strength of a convex cylinder, axis vertical, required by the eye signifies an increase in the refracting power of the eye in its horizontal plane and is here so noted. In oblique axes the listing is with that division to which the axis is nearest.

TABLE 1.—*Changes in Refraction of the Eye Operated on Noted at the First Postoperative Examination*

Type of Operation	Meridian	Significant Change, Percentage	Type of Change, Percentage	Average Change, Diopters
Lengthening	Vertical	60	93 (increase)	0.79
	Horizontal	32	87 (decrease)	0.57
Shortening	Vertical	24	75 (decrease)	0.83
	Horizontal	24	75 (increase)	0.67
Lengthening and shortening	Vertical	77	77 (increase)	1.05
	Horizontal	41	100 (decrease)	0.75

Although refraction was performed with great care and every effort was made to have each examination accurate to the nearest 0.25 diopter or less, all changes of less than 0.5 diopter have been disregarded in this report. All the changes considered significant in this study were 0.5 diopter or greater.

FIRST POSTOPERATIVE REFRACTION

Sixty per cent of the seventy eyes of sixty-two patients on which an operation was performed showed a change of 0.5 diopter or more in one or both meridians. Forty-one per cent of the fifty-four untouched eyes in this group showed such a change. In 20 per cent the change was greater in the untouched eye than in the eye on which an operation was performed.

Of the forty-two patients showing a change of 0.5 diopter or more in the eye operated on, the average change in the vertical meridian was 0.86 diopter. In the horizontal plane of the eye the average change was 0.65 diopter.

Subdividing the group according to the type of operation and excluding all changes of 0.25 diopter or less, one finds that when only

a lengthening operation (recession or tenotomy) was performed on one or both eyes (twenty-three patients and twenty-five eyes), 60 per cent of the eyes showed a significant change in the vertical meridian of the globe, 93 per cent of the changes being an increase in curvature, averaging 0.79 diopter. In the horizontal plane 32 per cent showed a significant change, 87 per cent of the changes being a decrease in curvature, averaging 0.57 diopter.

When only a shortening operation (resection, advancement or tuck) was performed and no simultaneous lengthening operation (sixteen cases, seventeen eyes), 35 per cent showed a change of over 0.25 diopter in one or both meridians; 24 per cent showed such a change in the vertical and 24 per cent in the horizontal plane. The vertical curvature decreased three times, averaging 0.83 diopter, and increased once 0.5 diopter. The horizontal curvature increased three times, averaging 0.67 diopter, and decreased once 0.5 diopter. Thus 75 per cent of the significant vertical changes represented a decrease in the refraction power, and 75 per cent of the horizontal changes represented an increase.

When a lengthening and shortening operation was performed on one eye (seventeen cases), 77 per cent showed a significant change in the vertical meridian, of which 77 per cent showed an increase in the curve, averaging 1.05 diopters, and 23 per cent, a decrease, averaging 0.83 diopter. In the horizontal plane 41 per cent changed, all showing a decrease, averaging 0.75 diopter.

After a lengthening operation 68 per cent of the eyes that had not been operated on showed no significant change in either meridian; 18 per cent changed in the vertical and 27 per cent in the horizontal meridian. Forty per cent of the fifteen eyes not operated on after a shortening operation showed a significant change, always a flattening, usually of 0.5 diopter. After a combined operation 29 per cent of the eyes not operated on showed a change in the vertical plane and 12 per cent in the horizontal plane. Except for 25 per cent of significant changes in the vertical meridian after the lengthening and the combined operations, all changes in the untreated eyes were decreases in curvature.

A study of the relation between the amount of change in the refraction and the amount of change in the squint resulting from the surgical intervention shows that the average change in the squint at the time of the first postoperative refraction was 19 degrees. Dividing all the eyes into two groups, it is found that after the sixty-two operations, twenty-seven eyes (of slightly less than half the patients) showed a change of 19 degrees or less in the amount of squint. The others showed a change of 20 degrees or more. Of the forty-two eyes operated on showing a postoperative change of 0.5 diopter or more, eleven

were in the first group and thirty-one in the second group. The amount of total change in refraction in the two groups was exactly the same, but the frequency of such changes was nearly three times as great (eleven to thirty-one) when the squint was changed 20 degrees or more after the surgical intervention. Similarly, in the twenty-two untreated eyes that showed a significant change, nine were in the first group of changes under 20 degrees; thirteen were over 20 degrees. Again the amount of change was identical in the two groups, but the frequency of change was 44 per cent greater in the latter group.

SECOND POSTOPERATIVE REFRACTION

A subsequent refraction was made for thirty-six or over half the patients, at a period averaging six months after operation. Of the thirty-eight eyes on which an operation was performed, 74 per cent showed a significant change from the first postoperative refraction in one or both meridians, and 62 per cent showed such a difference from the preoperative refraction. Thus three fourths of the eyes were continuing to change, and two thirds were still definitely different from their state before operation.

Of the untreated eyes, 41 per cent showed a change from the last refraction and 32 per cent from the preoperative refraction. With one exception these changes were in only one meridian of the eye and of only 0.5 diopter. Changes in the vertical meridian were nearly three times as frequent (four to eleven) as in the horizontal meridian, but there was an even division between increases and decreases in curvature.

Between the first and the second postoperative examination the changes in the treated eyes were 33 per cent more frequent in the vertical than in the horizontal meridian. Sixty-three per cent showed a significant change in the vertical meridian. Of these, 87.5 per cent were changes in the direction back toward the preoperative state, and only 12.5 per cent showed a continuation onward of a difference first noted at the first postoperative refraction. In the horizontal meridian 72 per cent of the significant changes were back and only 28 per cent onward. Only 32 per cent of the untreated eyes (thirty-four) showed a change in the vertical meridian; over half the changes were backward, but nearly as many were onward. In the horizontal meridian only 12 per cent showed a change, and the changes were equally divided between the two types. In the treated eyes 81 per cent of the significant changes were backward, and in the untreated eyes, 53 per cent.

A comparison of the total amount of change in refraction was made by adding the change in the horizontal and that in the vertical meridian, after excluding all changes of 0.25 diopter or less. By comparing these total changes it is found that between the preoperative and the first

postoperative refraction and between the first and the second postoperative refraction there were the following average changes:

Operation	Changes in Refraction, Diopters	
	First Postoperative	First to Second Postoperative
Eyes, operative treatment		
Lengthening	0.59	0.65
Shortening	0.34	0.46
Lengthening and shortening	1.09	0.95
Eyes, no operative treatment		
Lengthening	0.25	0.07
Shortening	0.30	0.30
Lengthening and shortening	0.29	0.35

There was a slight tendency for changes present at the second postoperative refraction to be greater when the amount of change in the squint was great in both eyes (only one eye having been operated on).

With a definite tendency manifest for changes to disappear as time goes on, it is of interest to compare the changes noted between the second postoperative refraction and the refraction before operation—an analysis of the semipermanent changes in the eyes.

In the group in which a lengthening operation was performed seventeen eyes were operated on and fourteen were not. Fifty-nine per cent of the eyes operated on showed a significant change in one or both meridians. In 75 per cent the vertical change had been an increase in curvature, and in 87 per cent the horizontal change had been a decrease. Ten of the fourteen untreated eyes showed no significant change. All the changes noted were decreases of curvature.

After the shortening operation (5 cases) 40 per cent showed a significant change in the eye operated on. All the changes represented a decrease of curvature. Only one of five of the untreated eyes showed a change.

In cases in which a lengthening and shortening operation had been performed on one eye (sixteen eyes operated on and fifteen eyes not operated on), 69 per cent (eleven) of the eyes operated on showed a significant change in one or both meridians. Seventy-five per cent showed an increase in the vertical curvature, and 86 per cent showed a decrease in the horizontal curvature. Sixty per cent of the eyes not operated on showed no significant change in either meridian. Usually the vertical and horizontal changes were of the same type as those in the eye operated on.

THIRD POSTOPERATIVE REFRACTION

At an average interval of 11.6 months after operation, a third refraction was performed in ten cases. In only one instance (after a shortening operation) did the eye operated on show no significant change in either meridian. Six of the ten eyes not operated on showed no change.

The differences between the preoperative and this third postoperative refraction were similar to the changes found at the second postoperative refraction. The changes noted were as follows:

After a lengthening operation three of the four eyes operated on showed a change in the vertical meridian, an increase in curvature averaging 0.83 diopter. In the horizontal meridian three of the four showed a change, two being a decrease averaging 0.75 diopter and one an increase of 0.75 diopter. In two cases the eye not operated on showed a significant change.

After a shortening operation two of the three eyes operated on showed a change: one a decrease of 0.5 diopter in the vertical plane and one a decrease of 0.5 diopter in the horizontal plane. One eye not operated on showed an increased curvature in both planes.

After a lengthening and shortening operation one of the three eyes that had been operated on showed an increase in vertical curvature of 0.5 diopter. The other two showed a decrease in the horizontal plane,

TABLE 2.—*Percentage of Significant Postoperative Changes in Refraction**

	0 to 1	0 to 2	1 to 2	0 to 3
Eye operated on.....	60	62	74	90
Eye not operated on.....	41	31	41	40

* 0 signifies the preoperative refraction; 1, 2 and 3 signify the first, second and third postoperative refractions, respectively.

averaging 0.82 diopter. One eye not operated on showed an increase in the vertical curvature of 0.75 diopter.

The eyes that had been subjected to a simple lengthening operation showed the greatest and most frequent changes. In these ten eyes the average change in amount of squint was 19 degrees at the time of examination.

CONTROL GROUP

All the changes that have been discussed might be ascribed to inaccurate refraction. To determine the consistency of the results, refraction was carried out twice on each of the members of a control group of nineteen unselected young (12 through 21 years, inclusive) patients from a tuberculosis unit. The determinations were made at intervals of more than two weeks. Seventeen of the nineteen studies were made two or three weeks apart. The other two were made at intervals of eleven and thirty weeks, respectively. The technic used was similar to that used for the main group of patients.

The average age of the patients in the control group was 18 years. No change of over 0.25 diopter in any meridian was noted in thirty-

three (87 per cent) of the thirty-eight eyes. Two eyes changed 0.37 diopter in one meridian, less in the other; in three eyes there was a change of 0.5 diopter, but in one of the latter cases the two refractions were made seven months apart. It seems fair to conclude that, taken as a whole, the refraction carried out in connection with this study was sufficiently accurate to warrant the drawing of conclusions based on the findings.

Although closely related to the problem of this study, the academic question of how such changes in refraction occur as a result of operation on the extra-ocular muscles and in what portion of the globe they are manifest cannot be adequately treated here. Theory and correlative evidence point to the cornea as the structure which by a change of curvature causes these changes in refraction in various meridians. It is unlikely that the effect could result from a change in the ciliary muscle, lens or posterior portion of the eye. Those authors who have mentioned the effect of the extra-ocular muscles on astigmatism have unanimously agreed that the action is on the cornea alone. To prove this point, keratometric readings were made in some instances in the present group of patients. Because of factors not easily controlled the entire group could not be so examined, and the relatively few measurements made do not warrant the drawing of conclusions from them. This aspect demands further study, but from a clinical and practical point of view the occurrence of changes in the total refractive error is the significant fact, whether they are actually limited to the cornea, as is most likely, or not.

Similarly, the mechanism of production of refractive changes in one eye after an operation on the muscles of the other eye is of considerable interest. Superficially, it would seem that gross errors had been made in the examinations. But such changes appear not illogical in a consideration of the conjugate functioning of the extra-ocular muscles of the two eyes. Jackson stated:[23] "An operation on any one of the muscles, if it alters the effect produced by contraction of that muscle, alters the general muscular balance." Since the two eyes function together in conjugate movements and in convergence, it follows that a surgical change in the tension of one or both of the horizontal rectus muscles of one eye might by reflex compensation alter the tension of the horizontal muscles of the opposite eye. Such changes appear to be relatively infrequent, minor and without pattern, in comparison with the changes in the eye operated on, yet frequent enough to warrant as careful observation as that given the eye on which the operation was performed.

---

23. Jackson, Edward: Operations on the Extra-Ocular Muscles, Ophth. Rec. **23**:541 (Nov.) 1914.

CONCLUSIONS

On reviewing the results, the following general conclusions are reached:

1. The refractive state of the eye usually changes as a result of operation on its extra-ocular muscles. These changes are more frequent when a lengthening operation is performed, with or without a simultaneous shortening operation, and when a large deviation is corrected. Sixty per cent of the patients in a group of fifty-five showed a change of 0.5 diopter or more in at least one meridian when discharged from the hospital postoperatively, the average change being 0.75 diopter.

2. The opposite untouched eye may show changes, though less frequently. Forty-one per cent of the eyes not operated on showed a significant change when the patients were discharged postoperatively.

3. Later observations showed that in the great majority of cases each eye tends to return to its preoperative state slowly, but since this tendency is often incomplete or overdone, permanent differences usually result. Six months postoperatively 61 per cent of the patients showed a significant change from the preoperative state in the eye that was operated on. A year after operation nine of ten patients showed such a difference. It cannot therefore be assumed that changes due to surgical intervention will in time correct themselves and disappear, even though they do show such a trend.

4. Refractive changes as a result of lengthening and shortening operations on the muscles correspond to the effect the increase or decrease of muscle tension consequent on the surgical treatment would have on the globe, if such changes are in the corneal curvature. Thus the usual change after a recession operation is an increase of the vertical refractive power and a decrease of the refractive power in the horizontal meridian. After resection of a lateral rectus muscle the opposite change usually occurs.

5. Although the type of change may be anticipated in general, the type and degree of the developments in the individual case are so uncertain that the final result cannot be foretold.

6. The frequency of changes in both the eye operated on and the eye not operated on points to the necessity of frequent postoperative testing of the visual acuity, with refraction and a change of lens whenever indicated.

SUMMARY

In the recent literature little note is made of changes in refraction caused by surgical treatment of the extra-ocular muscles.

Preoperative and postoperative examinations of a series of patients who had undergone surgical treatment for the correction of strabismus

showed significant changes in both the eyes that had been operated on and those that had not.

These facts show the importance of frequent determinations of the vision and refraction after such operations if postoperative orthoptic training is to be adequately performed and if the best possible vision is to be provided for the patient.

CONGENITAL HEAD-NODDING AND NYSTAGMUS

REPORT OF A CASE

RONALD A. COX, M.D.
WASHINGTON, D. C.

There are two conditions that have as their most prominent, if not only, symptoms head-nodding and nystagmus: The first is acquired head-nodding and nystagmus, or spasmus nutans. The second is congenital head-nodding and nystagmus, which may occur in several members of the same family. The differential diagnosis may be outlined as follows:

Spasmus Nutans	Congenital Head-Nodding and Nystagmus
1. The onset usually occurs between the fourth and twelfth month after birth, occasionally as early as six weeks after birth and sometimes as late as the third year	1. The onset is at birth
2. Recovery invariably takes place; the signs disappear usually before the end of the third year	2. The condition persists throughout life
3. No relation is found between the type of head movements and the type of nystagmus; the head movements are slow, inconstant and variable in range, and the eye movements are rapid, constant and of small and steady range	3. The head movements seem to compensate for the eye movements
4. The head-nodding precedes the onset of the nystagmus by from one-half to two months	4. The onset of the head-nodding and that of the nystagmus are simultaneous
5. Spasmus nutans is occasionally monocular	5. The congenital condition is always bilateral
6. The media are clear; the fundi appear normal.	6. The media are clear; the fundi appear normal

There are other conditions, such as multiple sclerosis, Friedreich's ataxia and Parkinson's disease, which have among their signs and symptoms head-nodding and nystagmus, but these conditions can be differentiated by their associated general and neurologic manifestations.

Presented before the Ophthalmic Division of the Philadelphia County Medical Society, Dec. 6, 1934.

REPORT OF CASE

History.—P. M., a boy aged 8, was brought to the clinic of Dr. Francis Heed Adler at the Wills Hospital, Philadelphia, in November 1934. His mother said she wanted something done to make his head and eyes stop shaking.

The patient had been born at full term and was normally delivered. Shortly after his birth the mother noticed that his head and eyes seemed to shake. Otherwise he was normal. Before the age of 3, he had rubeola, pertussis and a mild attack of bronchitis, all of which resolved satisfactorily without complications or sequelae. At the age of 3, he was taken to an ophthalmologist, who advised the mother that the condition would shortly disappear. Since the age of 3, the child has been normal in every way with the exception of the head-nodding and nystagmus.

The patient has two sisters, one 10 and one 12 years of age. Both are normal with no such ocular signs as the patient shows. Both have had rubeola and pertussis without complications, and each has had a prophylactic tonsillectomy and adenoidectomy. The father and mother have a normal history, and there is no history of tuberculosis, syphilis, malignant growth, or severe infectious or systemic disease in the family. There is, however, a very definite history of other members of the family having the same ocular manifestations as those which brought the patient to the hospital. There is no history of consanguinity.

Examination and Associated Clinical Tests.—External examination showed nothing abnormal except lateral movements of the head to both sides and lateral nystagmus in both eyes. Ophthalmoscopic examination showed that the media were clear and the fundi normal. The eyes were hyperopic. The patient was referred to associated clinics for a search for a focus of infection and for opinions, and to the refraction department for examination under a cycloplegic.

The dental report was that the teeth were normal. The otolaryngologist reported that there was tonsillar hypertrophy and advised a general tonsillectomy and adenoidectomy. The medical staff found chronic endocarditis and mitral insufficiency and referred the patient to the department of neurology. The neurologic report was: "The patient is neurologically normal except for nystagmus of the head and eyes; the head movements seemingly are to compensate for the eye movements. It is believed that the patient does not have a true nystagmus of the head but that the head movements are secondary to the eye movements."

The vision of the right and of the left eye was 6/9. Under cycloplegic refraction with atropine (1 per cent) the right eye took a +450 D. sph., which gave a vision of 6/7.5, and the left eye took a +450 D. sph., +100 cyl., axis 105°, which gave a vision of 6/7.5 also. The prescription was reduced +75 in each eye to allow for accommodative relaxation, and the glasses were ordered.

The Wassermann and the Meinicke tests were negative.

COMMENT

It is quite evident that this case does not fall into the category of spasmus nutans, in which the head and eye movements begin some time after birth and disappear about the end of the third year. It is also evident that there is a hereditary taint associated with the disease. On delving further into the family history it was found that seven of thirty known members of the family have the same head and eye movements. I considered it wise to investigate other members of the family

having the same signs and symptoms and, after some difficulty, succeeded in examining three of those having this condition. The accompanying chart illustrates the familial transmission of the nystagmus and head-nodding.

The first relative of the patient examined was his grandfather, aged 77, and evidently the transmitter of the condition in the cases recorded here. He knew nothing of his father, mother or siblings. So far as he was concerned, he had been in perfect health all of his life and had had excellent vision. His distant vision was 6/9 without correction. The other two persons examined were his daughters, ages 32 and 34, respectively, who were generally the same as their father. They had lived a normal life and had always been in good general health. One had good vision and had never worn glasses; the other wore glasses which cor-

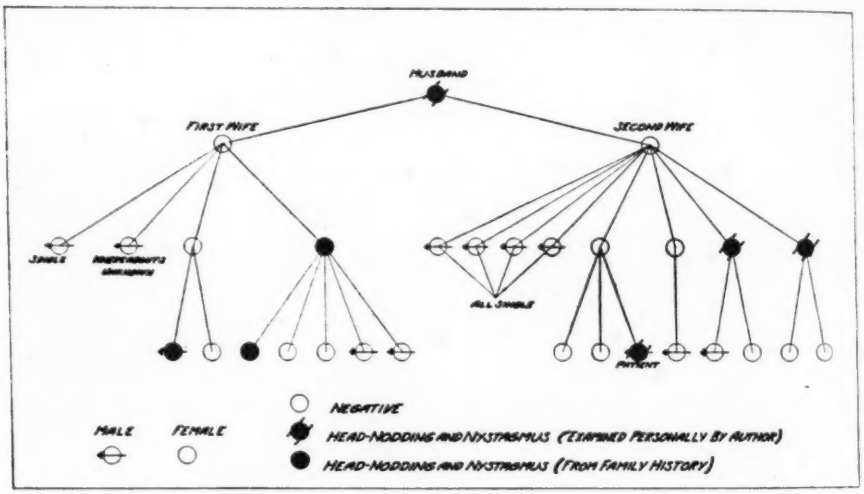


Chart showing familial transmission of nystagmus and head-nodding.

rected a small amount of hyperopia, and with which she obtained perfect vision. The histories of all three patients were irrelevant generally and were ophthalmologically negative with the exception of their head and eye shaking, which all had had since birth.

Concerning the nature of the head-nodding and nystagmus, all four members examined had horizontal nystagmus with a horizontal-oblique head-nodding. The patient, aged 8, had the most marked symptoms; the two aunts, aged 32 and 34, less marked, and the grandfather, aged 77, the least marked symptoms. It seems, therefore, that the condition tends to lessen in intensity as the subject grows older. Another characteristic of the phenomenon is that the head movements seem to com-

pensate for the eye movements. At times when the patient gazed into the distance abstractedly, the head movements almost ceased while the nystagmus was as active as ever. As soon as the patient fixed, however, there was acceleration of the head-nodding, and within ten seconds the head movements were fully active again. These cases, therefore, seem to fall into the group previously reported by various workers, the group of congenital nystagmus with associated head movements.

Hancock [1] reported several cases similar to those which I have reported here.

Nettleship [2] accumulated eleven instances of congenital nystagmus reported by other workers, in nine of which the condition was associated with head movements. One series of cases observed by Yawger was traced through four generations, and in all of these stammering was associated with the head movements. A case observed by Grove was described as one of "nystagmus of the pharynx and larynx" with resulting stammering. None of my patients showed any semblance of stammering. In studying his cases Nettleship observed that three observations were common to all: (1) that the head-nodding canceled the nystagmus to steady the retinal image; (2) that the head movements and eye movements were in the same plane, and (3) that all the patients had ametropia and pigmentary deficiencies (blue and gray irides). My cases substantiated his first two findings, but concerning the third one they did not hold: In my cases the patients were from an Italian family and all had dark brown irides, and there was present in the different ones both emmetropia and ametropia.

McGillivray [3] reports similar cases of congenital head-nodding and nystagmus in which the condition passed through four generations. Thorough physical examination revealed no organic cause of the phenomenon. He, also, believed that the head-nodding compensated for the nystagmus because (1) during sleep the head-nodding stopped though the nystagmus continued, and (2) the head movements were more active when the patient was fixing than when he was not. McGillivray believed also that the transmission usually occurred through the female members of the family.

Posey,[4] in 1902, thoroughly discussed associated movements of the head and eyes and mentioned several cases of congenital head-nodding and nystagmus brought to his attention by Randnitz.

---

1. Hancock, I.: Roy. London Ophth. Hosp. Rep. **17**:104, 1907.

2. Nettleship, E.: On Some Cases of Hereditary Nystagmus, Tr. Ophth. Soc. U. Kingdom **31**:159, 1911.

3. McGillivray, A.: Ophth. Rev. **14**:252, 1895.

4. Posey, W. C.: Associated Movement of Head and Eyes, J. A. M. A. **39**: 1365 (Nov. 29) 1902.

Moorad [5] reported a case of unilateral horizontal nystagmus in which, according to the mother of the patient, head-nodding accompanied the nystagmus but disappeared at the age of 4 months, before the patient was examined by Moorad. Moorad likens this case to those of miners' nystagmus, which is supposedly due to faulty illumination. This is considered by some workers to be the etiologic factor in spasmus nutans.

I am inclined to believe Moorad's case was one of spasmus nutans; in this condition the nystagmus sometimes begins as early as 6 weeks and disappears before the age of 4. The following facts strengthen my belief: 1. The nystagmus was monocular. 2. The head-nodding accompanied the nystagmus and stopped at the age of 4 months; the nystagmus stopped later. 3. There was no history of head-nodding or of nystagmus in the family for several generations.

TREATMENT

The treatment of patients with congenital head-nodding and nystagmus is the same as that of the average patient. If there is ametropia, it should be properly cared for; if there is emmetropia, the patient will have no visual difficulties from the movements of the head and eye. There is no known method of successfully treating the patient for head-nodding and nystagmus. My patient was given the correction for hyperopia, and today his vision is good. Incidentally, analysis of a large number of the cases in the literature shows that there is no certain type of refractive error which predominates in this entity.

SUMMARY

There are two conditions that have as their most prominent, if not only, symptoms head-nodding and nystagmus. They are (1) spasmus nutans and (2) congenital head-nodding and nystagmus. The differential diagnosis is given, and a case of congenital head-nodding and nystagmus is presented and discussed. The treatment of patients with congenital head-nodding and nystagmus is the same as that of the average patient.

5. Moorad, Philip J.: Nystagmus in Infants: Report of a Case of Monocular Horizontal Type, Arch. Ophth. **13**:238 (Feb.) 1935.

IS OCULAR PROPRIOCEPTIVE SENSE CONCERNED IN VISION?

S. R. IRVINE, M.D.
AND
E. J. LUDVIGH, PH.D.
BOSTON

In recent years, importance has been attributed to the part played by the proprioceptive sense of the extra-ocular muscles in orienting and modifying certain visual perceptions such as projection, stereopsis and the interpretation of motion on the retina. Disturbance of the proprioceptive sense has been cited as an etiologic factor in various motor anomalies, as nystagmus [1] and certain squints.[2] The work of Sherrington [2] has been accepted and interpreted as proof of proprioceptive sense in extra-ocular muscles by Duane,[3] Duke-Elder,[4] Adler [5] and Byrne [6] in their textbooks and by Karrer and Stevens [7] and McLean [8] in recent articles. In contemporary English literature on the extrinsic muscles of the eye this point of view seems prevalent, overshadowing that of such old authorities as Helmholtz,[9] Tscherning [10] and Hering,[11] who

---

From the Howe Laboratory of Ophthalmology, Harvard University, and the Massachusetts Eye and Ear Infirmary.

1. Bartels, M.: Ueber willkürliche und unwillkürliche Augenwegungen, Klin. Monatsbl. f. Augenh. **53**:358, 1914.

2. Sherrington, C.: Observations on Sensual Rôle of Proprioceptive Nerve-Supply of Extrinsic Ocular Muscles, Brain **41**:332, 1918.

3. Fuchs, E.: Text-Book of Ophthalmology, translated by A. Duane, Philadelphia, J. B. Lippincott Company, 1924.

4. Duke-Elder, W. S.: Text-Book of Ophthalmology, St. Louis, C. V. Mosby Company, 1933, vol. 1, p. 1051.

5. Adler, F. H.: Clinical Physiology of the Eye, New York, The Macmillan Company, 1933, p. 230.

6. Byrne, J. G.: Studies on the Physiology of the Eye, London, H. K. Lewis & Co., Ltd., 1933, pp. 39 and 81.

7. Karrer, E., and Stevens, H. C.: Response of Negative After-Images to Passive Motion of Eyeball and Bearing of These Observations on Visual Perception of Motion, Am. J. Physiol. **94**:611 (Sept.) 1930.

8. McLean, A. J.: An Attempt to Identify the Central Cells Mediating Kinesthetic Sense in the Extrinsic Eye Muscles, Arch. Neurol. & Psychiat. **17**: 285 (March) 1927.

9. Helmholtz, H.: Treatise on Physiological Optics, translated by J. P. C. Southall, Ithaca, The Optical Society of America, 1925, vol. 3.

10. Tscherning, M.: Physiologic Optics, translated by C. Weiland, Philadelphia, Keystone Publishing Co., 1900, chap. 21.

11. Hering, E.: Handbuch der Physiologie, Berlin, A. Hirschwald, 1880, p. 534.

attributed no importance to the proprioceptive sense of the eye muscles in the aforementioned visual perceptions. The influence of Sherrington no doubt gained impetus from a recognition of the importance of the proprioceptive sense in affecting posture in other skeletal muscles. The fact that the extra-ocular muscles are quite different anatomically and physiologically from other striated muscles has not been sufficiently considered. In view of the fact that many phenomena of visual perceptions are difficult to explain on the basis of proprioceptive sense, an analysis of the facts pertaining to proprioceptive sense in the extra-ocular muscles seems indicated.

Proprioceptive sense, as understood today, is the result of afferent impulses derived from specialized sensory endings located within the muscle fibers, surrounding connective tissue, tendons and joints. Its mechanism subserves stretch reflexes and carries sensations of position and vibration, thereby influencing posture and tone. It is called proprioceptive sense to distinguish it from the afferent pain and sympathetic impulses. It is not awareness of efferent impulses, a distinction which must be kept in mind if one is to differentiate various visual motor phenomena into their component parts. The necessity for postulating cognizance of efferent impulses in influencing these phenomena, as considered by the older ophthalmologists [9] and psychologists,[12] will be discussed later.

There is no doubt about the anatomic and physiologic evidence proving that afferent impulses from the muscle are present in skeletal muscle. Definite tests and criteria are used to indicate the presence or absence of these impulses constituting proprioceptive sense, namely: (1) the anatomic demonstration of specialized sensory end-organs, nerve fibers and tracts in the central nervous system subserving these; (2) the existence of vibration sense; (3) the existence of myotatic reflexes; (4) the existence of position sense.

In an attempt to demonstrate the presence or absence of proprioceptive sense in extra-ocular muscles our first step was to apply the preceding criteria.

ANATOMIC DEMONSTRATION OF A PROPRIOCEPTIVE MECHANISM IN THE EXTRA-OCULAR MUSCLES

Anatomic evidence, which consists in finding specialized end-organs, namely, muscle spindles, and the fibers and paths in the central nervous system subserving these, was first sought. The anatomy and histology have been treated in detail by one of us (S. R. I.) in a pre-

12. Myers, C. S.: Textbook of Experimental Psychology, London, Cambridge University Press, 1911.

vious paper.[13] The richness of their innervation is one peculiarity of the extra-ocular muscles which is frequently cited as evidence of proprioceptive sense.[14] It can be interpreted just as readily as part of a primitive neuromuscular mechanism.[15] Such a primitive neuromuscular mechanism seems inconsistent with a proprioceptive system modifying finely integrated perceptions. Typical muscle spindles, if present at all in the extra-ocular muscles, are certainly fewer and more primitive in type than those of skeletal muscles.[16] The neurotendinous organs of Golgi, however, are more consistently found,[17] although even these differ somewhat from and are less numerous than those found in the skeletal tendons.[17c] In fact, the presence of sensory nerves from the extra-ocular muscles and tendons is impossible to demonstrate anatomically and has to be judged by inference.[13]

VIBRATION SENSE IN THE EXTRA-OCULAR MUSCLES

For testing vibration sense, a small tuning fork was held over the eye muscles. No vibration was perceived, but this test as applied

13. Irvine, S. R.: Histology of Extra-Ocular Muscles Arch. Ophth. **15**:847 (May) 1936.

14. Sherrington.[2] Duke-Elder.[4]

15. Heidenhain, M.: Ueber progressive Veränderungen der Muskulatur bei Myotonia atrophica, Beitr. z. path. Anat. u. z. allg. Path. **64**:198, 1917-1918. Rollet, cited by Ramón y Cajal, S.: Histology, Baltimore, William Wood & Company, 1933, p. 275.

16. (*a*) Sherrington: Further Note on the Sensory Nerves of Muscles, Proc. Roy. Soc. London **61**:247, 1897; Constitution of Nerves of Skeletal Muscles with Remarks on Recurrent Fibers in the Ventral Spinal Nerve-Root, J. Physiol. **17**: 211, 1894. (*b*) Ruffini: On the Minute Anatomy of the Neuro-Muscular Spindles of the Cat and on Their Physiological Significance, ibid. **23**:190, 1898-1899. (*c*) Cilimbaris: Histologische Untersuchungen über die Muskelspindeln der Augenmuskeln, Arch. f. mikr. Anat. **75**:692, 1910. (*d*) Sutton, A. C.: Development of Neuro-Muscular Spindle in Extrinsic Eye Muscles of Pig, Am. J. Anat. **18**:117, 1915. (*e*) Schiefferdecker: Eigentümlichkeit im Baue der Augenmuskeln, Sitzungsb. d. nied.-rhein. Gesellsch. f. Nat. u. Heilk. zu Bonn **14**:54, 1905. (*f*) Crevatin, F.: Particolari forme di terminazioni nervose nei muscoli che muovono l'occhio, Rendic. Accad. d. sc. d. Ist. di Bologna **5**:37, 1900; Su di alcune forme di terminazioni nervose nei muscoli dell'occhio del dromedario, ibid. **6**:57, 1902.

17. (*a*) Hines: Studies on Innervation of Skeletal Muscle: Innervation of Extrinsic Eye Muscles of Rabbit, Am. J. Anat. **47**:1 (Jan.) 1931. (*b*) Golgi, C.: Sui nervi dei tendini dell'uomo e di altri vertebrati e di un nuovo organo nervoso terminale muscolotendineo, Torino Accad. d. sc. Mem. **32**:359, 1880. (*c*) Marchi: Ueber die Terminalorgane der Nerven (Golgi's Nervenkörperchen) in den Sehnen der Augenmuskeln, Arch. f. Ophth. **28**:203, 1882. (*d*) Ciaccio: Sur les plaques nerveuses finales dans les tendons des vertébrés, Arch. ital. de biol. **14**:31, 1890. (*e*) Huber, G. C.: Observation on the Degeneration and Regeneration of Motor and Sensory Nerve-Endings in Voluntary Muscle, Am. J. Physiol. **3**:339, 1900; Sensory Nerve Terminations in the Tendons of the Extrinsic Eye-Muscles of the Cat, J. Comp. Neurol. **10**: 152, 1900. (*f*) Sherrington.[16a]

to the eye muscle is not entirely conclusive since it fails also when applied to other muscles not in close proximity to bone.

MYOTATIC REFLEXES IN THE EXTRA-OCULAR MUSCLES

The dependence of tone and reciprocal innervation phenomena on myotatic reflexes in skeletal muscle has made neurophysiologists assume the presence of proprioceptive impulses in the extra-ocular muscles without absolute proof. There is no doubt that the extra-ocular muscles have tone, yet Hoffmann [18] was unable to demonstrate a stretch reflex in the extra-ocular muscles of man, and McCouch and Adler [19] could not elicit it in cats. During operations for squint we have attempted to observe a stretch reflex by pulling on the muscle. The tension was increased, but no typical quick myotatic contraction could be observed.

The increase in tension, simulating the withdrawal reflex or the contraction of smooth muscle after the application of a mechanical stimulus, may be due to accompanying pain. The local anesthesia was obtained with cocaine and procaine hydrochloride. Although it has not been demonstrated that local anesthesia diminishes the tone of the extra-ocular muscles, the anesthesia may have inhibited the stretch reflex in these patients.[20] This, however, seems improbable in view of the fact that the stretch reflex is considered the basic mechanism of tone in striated muscle. This complication as to anesthesia was eliminated in the experiments of McCouch and Adler, who used decerebrate animals. If local anesthesia diminishes proprioceptive sense it is surprising that incoordinated eye movements resulting from anesthesia have not been reported, as would be expected if proprioceptive sense is as important for the eye as for the limbs in carrying out coordinated movements. Certainly knowledge of the fundamental mechanisms controlling tone is still incomplete.[21] This is especially true with regard to flexor muscles. To quote Sherrington: [21]

---

18. Hoffmann, P.: Ist es möglich die physiologischen Erfahrungen über die Sehnenreflexe mit den pathologischen in Einklang zu bringen? Nervenarzt **2**:641, (Nov. 15) 1929.

19. McCouch, G., and Adler, F.: Extraocular Reflexes, Am. J. Physiol. **100**: 78 (March) 1932.

20. Bremer, F.: Pharmacologie du tonus musculaire, Rev. neurol. **2**:403 (Oct.) 1931. Liljestrand, G., and Magnus, R.: Ueber die Wirkung des Novokains auf den normalen und den tetanusstarren Skelett-muskel und über die Entstehung der lokalen Muskelstarre beim Wundstarrkrampf, Arch. f. d. ges. Physiol. **176**:168, 1919.

21. Sherrington, in discussion on Cobb, S., and Wolff, H. G.: Muscle Tonus: A Critical Review Based on Work Presented at the International Neurological Congress, Bern, Switzerland, 1931, Arch. Neurol. & Psychiat. **28**:661 (Sept.) 1932.

A point which . . . . seems to me remarkable and striking in laboratory experience of skeletal-muscle tonus, is the much greater prominence and ease of exemplification of postural tonus in extensor muscles (antigravity muscles) than in flexors. In the laboratory we have still no reliable way, apart from the use of drugs, by which to obtain a good tonic or hypertonic flexor preparation. The qualities of the postural tonus of the flexor muscle are therefore relatively little known. Questions which are natural to ask about it remain still without answer. Does it require for its maintenance the afferent nerves of the flexor muscles themselves? Is it reflex, and proprioceptively reflex? Does the tonus of the flexor muscle like the extensor muscle give evidence of reflex excitation arising from the receptors of the muscle itself (autogenic)? Again, does the flexor like the extensor give evidence of self-inhibition reflexly developed from the receptors of the contracting muscle itself (autogenic inhibition) e. g., lengthening reaction? I fancy there is no evidence at present that the receptors in flexor muscles differ from those in extensor muscles (certainly there are muscle-spindles and Golgi-organs in both); so far as I know the afferent nerve fibers of the flexor are as numerous and of the same appearance as those of the extensors. Yet of the proprioceptive reflexes of the flexors including tonus itself little is known as compared with what is known for the tonus of the extensors.

The eye muscles are flexor muscles. The possibility of a mechanism entirely different from that of skeletal muscles maintaining tone in the extra-ocular muscles cannot be put aside since there are distinct differences in the anatomic structure and physiologic behavior of these muscles. Anatomically, there is a certain resemblance to cardiac muscle,[22] with definite evidence of a primitive neuromuscular mechanism as in cardiac and smooth muscle. The reaction to acetylcholine and nicotine shown by Duke-Elder [23] represents another similarity of the extra-ocular muscles to smooth muscle and primitive types. Our experiments indicate an increased threshold to electrical stimulation, which also suggests a functional similarity of the eye muscles to smooth muscle: At the time of certain enucleations we attempted to produce contraction in the extra-ocular muscles, using galvanic or faradic currents. The stimulus used was sufficient to cause contraction of the arm muscles, and when applied to the eye muscles by placing a padded electrode on the eyebrow and a needle electrode in the belly of the muscle it was sufficient to cause contraction of surrounding muscles including the masseter. Yet no contraction of the eye muscle was obtained. Our technic did not allow the electrode to be placed at the origin of the muscle or definitely on a motor point, yet the spread of the stimulus to surrounding muscles shows that the threshold for response from extra-ocular muscles is higher than for other muscles. As Bielschowsky has noted,[24] the current

22. Schwartz: Ueber das Vorkommen quergestreifter Ringbinden bei den Augenmuskeln, Ztschr. f. d. ges. Anat. (Abt. 1) **75**:361, 1925.

23. Duke-Elder, W. S.: New Observations on the Physiology of the Extra-ocular Muscles, Tr. Ophth. Soc. U. Kingdom **100**:181, 1930.

24. Bielschowsky, A.: Lectures on Motor Anomalies of Eyes: Functional Neuroses; Etiology, Prognosis and Treatment of Ocular Paralysis, Arch. Ophth. **13**:751 (May) 1935.

needed to stimulate the extra-ocular muscles to contraction is dangerous to the retina; this test can be applied safely only on useless eyes.

The inhibitory phase of reciprocal innervation demonstrated in the eye muscles by Sherrington [25] and de Kleyn [26] was of central origin and not dependent on myotatic reflexes. Likewise the effect of other stimuli on the tone of the extra-ocular muscles, as hearing, sight, labyrinthine and cervical reflexes, and cerebellar influence, indicates that these are all afferent impulses which apparently can directly influence the oculomotor nerves, and, as far as we know, are not dependent for final action on any afferent impulses from the extra-ocular muscles themselves. The presence of proprioceptive impulses from the extra-ocular muscles influencing the iris has been assumed by Byrne,[6] who noted increased sensitivity of the iris to miotics after injury to the extra-ocular muscles. The sensitivity was increased in a similar way after direct stimulation of known proprioceptive nerves in other parts of the body. This work might be interpreted as indirect evidence of proprioceptive sense in the eye muscles, but in a second experiment Byrne [6] proved that this effect was carried by the fifth nerve, because, after extirpation of the fifth nerve at or near the gasserian ganglion, no increased sensitivity was obtained. In view of the work of Sherrington,[27] McLean [8] and Hines [17a] disproving any anatomic connection between the oculomotor nerves and the fifth nerve at or below the gasserian level, it is questionable whether Byrne's work is even indirect evidence of proprioceptive sense.

Thus it is seen that there is no objective physiologic or anatomic proof of the existence of proprioceptive sense in the eye muscles or tendons. Until other methods of attack on this problem are applied, such as those suggested by Buzzard and Greenfield [28] in demonstrating that sensory nuclei have rates of degeneration different from those of motor nuclei, or by Gasser and Erlanger [29] in showing a proprioceptive and a motor component to action currents taken from nerves, or in the use of selective drugs, satisfactory evidence will be wanting. The failure to find afferent pathways distinct from the motor pathways in

25. Sherrington, C.: Experimental Note on Two Movements of the Eye, J. Physiol. **17**:27, 1894.

26. de Kleyn: Ueber vestibuläre Augenreflexe, Arch. f. Ophth. **107**:480, 1922.

27. Sherrington, C.: Further Note on the Sensory Nerves of the Eye-Muscles, Proc. Roy. Soc. London **64**:120, 1898.

28. Buzzard, E. F., and Greenfield, J. G.: Pathology of the Nervous System, New York, Paul B. Hoeber, Inc., 1923.

29. Gasser, H. S., and Erlanger: Rôle Played by Sizes of Constituent Fibers of Nerve Trunk in Determining Form of Its Action Potential Wave, Am. J. Physiol. **80**:522, 1927.

the extra-ocular nerves leads one to assume that sensory fibers from the extra-ocular muscles must be carried in the motor nerves,[30] a situation making objective experimentation difficult by any method suggested.

POSITION SENSE IN THE EXTRA-OCULAR MUSCLES

Appreciating this lack of objective evidence, Sherrington [2] ingeniously attempted to demonstrate the presence of proprioceptive sense for the eyes by proving the existence of position sense for the eyes. He reasoned that if there is position sense for the eyes there must be a fortiori proprioceptive sense for the mediation of position sense. He interpreted two old and oft-repeated observations from the point of view of proprioceptive sense. The first observation was as follows:

> If, in an entirely dark room we direct the eyeballs in this direction or that, we, although without retinal guidance, are still aware of the directions given to the eyeball. And this is so even when the whole front of the eyeball and the inner surface of the lids have been rendered insentient by cocaine. The direction of the eyeball is then judged almost as accurately as with the use of the retina in the undarkened room. Such appreciation of the position of the eyeball must be attributed to muscle sense.

Under simple conditions the observer may know where his eyes are, but whether he knows this by proprioceptive sense or because he has just voluntarily placed them there is not clear. It is well known that the patient with a "phantom" limb describes in considerable detail just what movements he is making with the amputated member, although the possibility of proprioception from the limb is definitely eliminated.

If a small area of the conjunctiva near the limbus is touched with a swab saturated with a 4 per cent solution of cocaine, the conjunctiva in this area may be grasped with forceps and the eye moved passively. If the eye is thus moved in the dark, no sensation of movement is aroused and the observer cannot state the position of his eye. If an extreme deviation of the eye is produced in this manner, there is a slight feeling of discomfort, but this contributes nothing to the ability to localize the position of the eye. In our observations on passive movement, the effect of anesthesia in inhibiting any proprioceptive sense did not seem likely, as the same results were obtained on moving the eye with pressure by the finger. We also confirmed our observations with regard to passive movement by experiments on a patient whose gasserian ganglion had been extirpated. We are aware of the possibility that proprioceptive fibers may travel in the fifth nerve. However, if proprioceptive sense is carried by the fifth nerve and is important in

30. Hinsey, J. C.: Innervation of Skeletal Muscle, Physiol. Rev. **14**:514 (Oct.) 1934. McLean.[8] Hines.[17a] Sherrington.[27]

the coordination of eye movements and in spatial projection, it is significant that no difficulty of this kind is reported in these cases.[31]

An experiment leading to a similar conclusion may be easily carried out with a person who has a recently paralyzed muscle. If such a person is placed in a dark room and asked to move his eye to the paralyzed side he feels that the eye has moved, although it has not, and proprioceptive sense should tell him that it has not.

Clinically one sees the failure of position sense to guide fixation when only a small central field of vision is retained, as in patients with glaucoma or retinitis pigmentosa. If a patient with such restriction is told to turn his eyes a certain amount in any direction to fix a flashlight, he does so in a very ataxic manner. Even if given explicit directions, so that he can imagine where the light is accurately enough to touch it, still his eyes wander about in a hit or miss fashion until the light is seen, mainly by chance.

The ataxic movements of the eyes of blind persons are evidence that the afferent coordinating mechanism is not that of proprioceptive sense but the retina. In view of the foregoing observations it seems very difficult for one to maintain the position that there is conscious proprioceptive sense, meaning by this that one knows where the eyes are as one knows where the limbs are. It becomes necessary to modify the concept of proprioceptive sense, and Tschermak,[32] realizing this, has suggested that, in the eye, proprioceptive sense is not perceived as such, but that it nevertheless influences the perception of objects. Sherrington's second line of argument follows this course by pointing out that a vertical line observed straight ahead remains vertical when observed at an oblique angle. To quote directly,

> With the head erect let three spots A, B, C be looked at directly in front, for instance, on a bare wall across the room. Let us suppose one eye only to be used, the other closed. Let the three spots be equally spaced and in one vertical; and suppose the middle one B the point of visual fixation, and at the level of the eye so that the eyeball is in the so-called "primary" position. Suppose A to lie above B and C below B. The spots are perceived as forming one vertical. How is their verticality recognized? An answer often accepted is as follows: The spots stimulate three retinal points α,β,γ, the mental reaction attaching to which give sensual "verticality" as an attribute inherent in the perception of those points taken as a group. Let us test this statement. Without moving the head, let the eye be directed toward three similar spots A′, B′, C′, on some other part of the wall, say higher to the right and lying in one vertical, and let the middle one B′ be fixated. . . .
>
> Then these three spots are perceived likewise as situate in one vertical. But Listing's law of the postures of the eyeball tells us, and its demonstration proves

31. Carmichael, E. A., and Woollard, H. H.: Some Observations on Fifth and Seventh Cranial Nerves, Brain **56**:109 (July) 1933.

32. Tschermak: Optischer Raumsinn, in Bethe, A., and others: Handbuch der normalen und pathologischen Physiologie, Berlin, Julius Springer, 1931, p. 977.

to us, that in the second case, although the spot B′ stimulates the same retinal point β as did B, the spot A′ does not stimulate the retinal point α as did A but a retinal point α' lying to the right of α and the spot C does not stimulate the retinal point γ, but point γ', lying to the left of γ.

Sherrington concludes that since two different retinal impressions are made in the primary and secondary positions but are interpreted similarly, another factor must have corrected the second impression, and this factor he considers to be the proprioceptive sense of the extra-ocular muscles. However, two different retinal impressions may obviously give rise to the same interpretation even with no change in the position of the eyes, thereby excluding any proprioceptive factor. An example is the presentation to the retina of a round plate in two different positions, so that a round image is formed in the first instance and an elliptic image in the second instance. The observer interprets the plate as being round in both cases. He knows this from experience, regardless of the retinal image. In a similar manner, the observer may interpret the line as vertical in the second position of the eye in Sherrington's experiment by allowing for a displacement of the image on the retina always occurring when the eye is turned up and to the right. Likewise, as long as two lines on a wall have any other plane of retinal reference, as the ceiling or the floor, the chances of correct interpretation are good. If all reference is taken away, as in Aubert's phenomenon,[33] there is an appreciable error in determining verticality with the eyes or head in different positions. If the plane of reference is distorted, no proprioceptive sense keeps one from misinterpreting the retinal picture of verticality or parallelism of two lines.

Sherrington's analysis went further. He qualified the foregoing observation by projecting the after-image of the first three points up and to the right and noted a clockwise inclination of the after-image. Reversing this, projecting the after-image of the second set of dots straight ahead, a counter-clockwise inclination was noted. The retinal stimulation was then constant but interpreted differently in the two positions. Since the posture of the eyeball was the only factor changed, he attributed the change in interpretation to proprioceptive sense. In Zollner's illusion one may produce a decided change in the interpretation of a single impression (by seeing the figure as ground), as Helmholtz [9] has observed, without change in the posture of the eyeballs, again showing that the perception is a function of more than the one variable, retinal impression. If one repeats this part of Sherrington's experiment, using a lighted slit in a dark room, and moves the eye to the second position passively by means of forceps applied to a small area of anesthetized conjunctiva, there is no movement of the after-image.

33. Aubert, H.: Physiologie der Netzhaut, Breslau, E. Morgenstern, 1865.

If proprioceptive sense were so discriminating in Sherrington's case as to distinguish slight degrees of inclination from the vertical, one would expect some movement of the after-image with passive movement of the eyeball. This lack of movement of after-images with passive movement of the eye was noted by Helmholtz.[9] He displaced the eyeball by pulling on the skin at the outer canthus. Conversely our observations show that an unsuccessful attempt at voluntary movement, as when the eye is restrained or when the muscle involved is paralyzed, results in an apparent movement of an after-image.

Similar results follow restraint when binocular projection is involved, as in Tscherning's [10] experiment, which shows that the projection of after-images is not dependent on the position of the eye. He obtained an after-image in the right eye, then displaced the eyeball passively by pinching the skin at the outer canthus of this eye, and fixed with both eyes a point to the extreme left. He saw the after-image at the point of fixation, in spite of the fact that the right eye was definitely divergent and not fixing where the after-image appeared.

It appears that at present the existence of even unconscious proprioceptive sense is against the weight of evidence.

But Tschermak has attempted to overcome these further objections by making an additional assumption, namely, that the proprioceptive sense of the extra-ocular muscle differs from that of skeletal muscle not only in being unconscious but also in not responding to passive extension. This further hypothesis, if substantiated, would invalidate our experiments by forceps displacement and Helmholtz' experiments by finger displacement.

In view of the sense of position that one has in other parts of the body on passive movement, Tschermak's second assumption would seem utterly unreasonable if it were not for the report of Denny-Brown [34] suggesting that the mammalian muscle spindles in the flexor muscles are organs responding to active contraction only and not to passive stretch. This contention has been proved incorrect by Matthews,[35] whose experiments demonstrate that there is definite response of these organs to passive stretch.

In recent nystagmus the environment appears to move, although proprioceptive sense should give information of the position of the eyes and permit a correction as in Sherrington's second observation.

It thus appears that the assumption that the proprioceptive sense of the extra-ocular muscles does not respond to passive stretch stimuli

---

34. Denny-Brown, D. E.: Inhibition as Reflex Accompaniment of Tendon Jerk and of Other Forms of Active Muscular Response, Proc. Roy. Soc., London, s.B **103**:321 (Sept.) 1928.

35. Matthews, B.: Response of a Single End-Organ, J. Physiol. **71**:64, 1931.

is unsupported by evidence and is in conflict with Matthews' finding. Furthermore, even if the assumption is in fact true, it is difficult to explain the apparent movement of the environment in nystagmus, which certainly consists of active muscle contractions.

However, Karrer and Stevens [7] have studied the interpretation of motion on the retina and have brought forward still a third hypothesis to bolster the proprioceptive theory. These authors observed that both passive and reflex motion of the eyes produce an impression of movement of the environment, whereas with active motion of the eyes the environment appears fixed. Thus active movement of the eyes results in proprioceptive impulses which convey the information that it is the eyes which have moved and not the environment, while passive or reflex movement does not excite proprioceptive impulses and therefore the observer does not realize that his eyes are moving and considers that the environment is moving.

Here the assumption has been made that not only is passive movement insufficient to stimulate the proprioceptors, but that reflex movement is likewise inadequate for this purpose. This position is difficult to maintain. It seems unlikely that proprioceptive end-organs can distinguish between the muscle contraction following reflex innervation and that following voluntary innervation. Whether or not the environment will move with movement of the eyes is now dependent on the locus of the origin of the innervation, and this is very like an innervation theory, but the proprioceptive sense is still retained, although it can now send or not send proprioceptive impulses only at the behest of innervation.

Even this reformed concept of proprioceptive sense runs into experimental difficulty. Thus, if the experiment with the person who has a recently paralyzed muscle is performed in the light, he again judges that the eye has moved when it has not and interprets the environment as having moved in the direction in which he has attempted to move the eye. The possibility of the unparalyzed conjugate muscle on the other side sending afferent impulses of movement so that the patient interprets movement of the paralyzed eye by means of these impulses from the unparalyzed muscle is ruled out by repeating the experiment with a person who has both conjugate muscles paralyzed.[12] The only apparent objection to this experiment is that the observer's motor apparatus is not normal. Mach,[36] however, cited an experiment which demonstrates that an interpretation of motion may occur with neither spatial-gradient retinal guidance nor proprioceptive sensations. If an

36. Mach, E.: Grundlinien der Lehre von den Bewegungsempfindungen, Leipzig, Wilhelm Engelmann, 1875, p. 83.

observer is shut in a closed round receptacle and the receptacle with the observer set in rotation toward the right, the receptacle will appear to the observer to be in rotation owing to labyrinthine stimulation, although every cue of inference for relative rotation is wanting. If his eyes perform involuntary compensatory movements to the left, the images on the retina are displaced, and a sensation of movement toward the right results. If, however, he fixates the eyes on a spot on the receptacle, he must voluntarily compensate the involuntary movements, and thus again he is conscious of movement toward the right.

Convergence is ordinarily thought of as a voluntary movement and hence should be expected to stimulate the nerves alleged to be proprioceptors. Yet the following simple experiment is adequate to show that even under conditions of extreme convergence the observer does not know where his eyes are. The eyes are closed and a prism of maximum strength consistent with binocular fixation is placed before one eye. The eyes are then opened and an object is fixed. The observer cannot now state even whether his eyes are converging or diverging, although the actual deviation may be well over 20 prism diopters.

This experiment might be argued against because the use of prisms before the eyes is unusual. It is then sufficient to note that on voluntary convergence the environment appears to move, although here the proprioceptive sense should certainly exercise its corrective influence.

Finally it might be argued that despite all evidence to the contrary proprioceptive sense must be assumed for the eye in view of the extraordinarily fine eye movements of only a few seconds of arc which can be executed. However, it is just during the execution of these fine eye movements that the possible influence of the proprioceptive sense must be excluded because of the relatively great angular velocity of eye movements.[37] Thus, even assuming (all of which is ridiculous) that there were no latent time of reaction of the alleged proprioceptors and that, uninterrupted by synapses, the proprioceptive impulses traveled to the fifth nucleus thence to the oculomotor nucleus and thence to the appropriate muscle at the rate of 120 meters per second, complete eye movements of the order of 3,000 seconds could take place before the result of the proprioceptive impulse arrived back at the muscle. If the proprioceptive impulse must first go to the higher centers, then, in view of the greater velocity of the larger eye movements, displacements of the order of 5 degrees could take place before the alleged proprioceptive impulse could become effective.

---

37. Guillery: Ueber die Schnelligkeit der Augenbewegungen, Arch. f. d. ges. Physiol. **73**:87, 1898.

Almost all of the facts discussed here seem more compatible with the hypothesis of an innervation sense than with that of a proprioceptive sense and suggest a return to the views held by older writers such as Helmholtz, Hering and Tscherning.

SUMMARY AND CONCLUSION

The proprioceptive sense in the extra-ocular muscles has been tested for and found lacking by application of the usual criteria, namely: (1) histologic and anatomic evidence, (2) vibration sense, (3) myotatic reflexes and (4) position sense. For the possibility that ocular proprioceptive nerves not mediating position, operating at a low level, exist there is no physiologic evidence. We have disproved the existence of position sense derived from the extra-ocular muscles and are forced to the conclusion that proprioceptive sense, if extant in the extra-ocular muscles, plays no rôle in projection, stereopsis or the interpretation of motion on the retina.

TWINNING AND OCULAR PATHOLOGY

WITH A REPORT OF BILATERAL MACULAR COLOBOMA IN MONOZYGOTIC TWINS

ARNOLD GESELL, M.D.
Director of the Yale Clinic of Child Development
AND
EUGENE M. BLAKE, M.D.
Clinical Professor of Ophthalmology, the School of Medicine, Yale University
NEW HAVEN, CONN.

Bilateral macular coloboma is a rare congenital anomaly, only a small number of cases having been reported. This makes the occurrence of four remarkably similar colobomas in the four eyes of a pair of twins especially noteworthy. Apart from their significance for ocular pathology, the cases reported herewith furnish a remarkable instance of exquisitely detailed concordance in monozygotic twins.

We first present the results of comparative observations of twins A and B and then discuss the physiology of twinning in the genesis of coloboma. The literature is surveyed, and the reports of various ophthalmologic correspondences in twins are summarized to indicate the developmental factors at the basis of pathologic conditions of the eyes.

REPORT OF CASE

The subjects were a pair of otherwise relatively normal twin girls. In spite of their eagerness and vivacity they had been handicapped in their school progress and were referred to the Yale Clinic of Child Development, where physical and mental measurements were made. The measurements and comparative data when the twins were 10 years old are summarized in tables 1 and 2.

The resemblances, both physical and functional, were impressive. Twin A was slightly superior in height, weight, intelligence and reading ability. The differences, however, were almost negligible and were much less than those found among ordinary siblings. In numerous items the similarity was thorough. In a vocabulary test the children succeeded and failed, with only one exception, on the same words. Even their errors in spelling were often similar. Their temperamental traits, tastes, sense of rhythm, inflections of the voice and phonetic deviations also were alike. When they sang a duet the harmony seemed complete. The twins were clearly monozygotic.

Such unison or, rather, concordance is unquestionably based on a fundamental identity of genetic constitution, which comes into expression in the friction ridges of the skin, in the trends and patterns of behavior and, most strikingly of all, in common pathologic changes in the eyes.

From the School of Medicine, Yale University.

The twins, aged 10 years, were first examined by one of us (E. M. B.) on Oct. 19, 1933. They were referred to the clinic because of defective vision.

Family History.—The father, aged 52, was well and had no disease or abnormality of the eyes, beyond normal presbyopia. One of the father's older sisters, residing in England, was said to have suffered from glaucoma. A 30 year old son by a former marriage was examined and found to have perfectly healthy eyes, and his 4 month old infant also had normal eyes. The mother of the twins, aged 40, was entirely healthy, and an examination of her eyes revealed no abnormalities. A sister of the twins, aged 13, was examined and found to be free from ocular defects, beyond slight hyperopic astigmatism. In other words, so far as could be learned by interrogation and examination, there was no evidence of ocular disease or aberration which might account for the changes to be described in the identical twins. Nothing occurred during pregnancy which could be considered as having had a possible influence on their development.

Past History.—The twins were born at full term, and delivery was spontaneous. Shortly after birth it was noticed that the eyes were in constant motion. Examination by several competent ophthalmologists revealed changes in the eyegrounds and nystagmus. No treatment was recommended. The twins entered school at

Fig. 1.—Twins A and B, aged 12 years.

the age of 6 but made rather poor progress because of their defective vision. Physical examination revealed no other abnormality. The Kahn test of the blood was negative.

Present Status.—Both children complained of poor vision; neither had ever worn glasses. The lids, conjunctivae and palpebral fissures were normal. There was rather coarse horizontal nystagmus to the left in each pair of eyes, the nystagmus increasing on attempts at fixation and through nervous excitation and later slowing down somewhat. Ocular rotation was normal in all directions. There was divergence of the left eye, estimated as 20 degrees, in twin A, and divergence of the right eye, estimated as 10 degrees, in twin B. These measurements were only approximate, as the angle of deviation varied in each child and the nystagmus prevented a satisfactory estimation of its extent. Twin B's pupils were equal, but in twin A the left pupil was 0.5 mm. wider than the right. The pupillary reactions were prompt in both children. The irides were gray-blue and in no way remarkable. Examination with the biomicroscope was impracticable because of the nystagmus. The ocular media were entirely transparent, except for the remains of the hyaloid canal, present in both left eyes.

TABLE 1.—*Physical Characteristics*

	Twin A	Twin B
Height		
Vertex	144.7 cm.	142.05 cm.
Suprasternal	116.7 cm.	115.05 cm.
Symphysis pubis	77.0 cm.	76.50 cm.
Diameter		
Biacromial	31.8 cm.	30.50 cm.
Mesosternal	22.1 cm.	20.80 cm.
Iliocristal	22.1 cm.	21.60 cm.
Head, circumference	49.9 cm.	49.80 cm.
Weight	72.75 lb. (33 Kg.)	66.75 lb. (30 Kg.)
Teeth		
Carious	3	4
Form of molar cusps	Similar	Similar
Eruption	Remnant, deciduous upper left first premolar; upper central lateral incisors sharply angulated	Remnant, deciduous upper left first premolar; lateral incisor erupting; upper central lateral incisors sharply angulated
Upper palate, maximum transverse diameter	6.5 cm.	6.5 cm.
Lower jaw, maximum transverse diameter	6.5 cm.	6.3 cm.
Upper palate, anteroposterior diameter	5.2 cm.	5.0 cm.
Lower jaw, anteroposterior diameter	5.0 cm.	4.2 cm.
Upper central incisor, maximum width	9.0 mm.	9.0 mm.
Lower central incisor, maximum width	6.0 mm.	6.0 mm.
Hair		
Color	E to B	E to C
Texture and abundance	Similar	Similar
Whorls	Counterclockwise	Clockwise
Palmar prints	L: 11-9-7-5 R: 11-10-8-5	L: 11-9-7-5 R: 11-9-7-5
Dermal characteristics	Similar	Similar
	5 moles; 2 freckles	5 moles; 2 freckles
Eyes, color	Same in two eyes, norm 6	Same in two eyes, norm 6
Vision (corrected)	R: 4/200 L: 10/200	R: 4/200 L: 10/200

TABLE 2.—*Psychologic Characteristics*

	Twin A	Twin B
Mental age	8 years 7 months	8 years 7 months
Intelligence tests given	18	18
Identical successes	7	7
Identical failures	8	8
Reading		
Speed: paragraph 1	16 sec.	23 sec.
paragraph 6	33 sec.	65 sec.
Errors: paragraph 1	2	2
paragraph 6	5	10
Oral reading score	3.70	2.8
Written spelling score	1.50	1.5
Oral spelling score	2.05	1.8
Vocabulary score	18.00	18.0
Porteus maze	Similar	Similar
Drawings	Similar	Similar
Motor coordination:		
Block building, average time	12.85 sec.	15.71 sec.
Voice	Similar	Similar
Mispronunciations	Similar	Similar
Misspellings	Similar	Similar
Preferences	Similar	Similar
Games played	Similar	Similar
Reactions to discipline	Similar	Similar
Appetite	++	+
Spontaneity	++	+
Smiling	++	+
Laterality		
Writing	Right	Right
Throwing	Right	Right
Batting	Right	Right
Kicking	Right	Right
Thumbs up in folded hands	Right	Right
Eye dominance	Right	Left

Vision in the right eye in twin A was 13/200 with —5.00 sph. ⊃ —0.50 cyl., axis 60°. Vision in the left eye was 5/200 with —5.00 sph. Fingers were counted at 6 feet (180 cm.) with the right eye and at 3 feet (90 cm.) with the left eye. In twin B vision in the right eye was 9/200 with —3.50 sph. and 20/200 in the left eye with —2.50 sph. ⊃ —1.00 cyl., axis 135°. Fingers were counted at 4 feet (120 cm.) with the right eye and at 10 feet (300 cm.) with the left eye.

The fundi were examined repeatedly after the administration of a 0.25 per cent solution of scopolamine hydrobromide. The eyegrounds were of the blond type, corresponding to the general complexion. The choroidal vessels were plainly visible only toward the periphery.

Twin A: The description of the coloboma of the right eye of twin B suffices in all respects for twin A, except that the area was oval, its long axis running up and in, about 45 degrees from the vertical. The long axis was about 25 per cent greater than the short axis. Somewhat more pigment was present than in twin B's right eye. In the left eye of twin A the coloboma was oval, its long axis being approximately horizontal. This was the only one of the four colobomas which showed vessels crossing its site. Above, near the border of the affected area, was a small branch of the superior temporal artery. At a practically corresponding point below was a similar twig from the inferior temporal artery. The center of the

Fig. 2.—Myopic manipulation of twins A and B in a block-building test (from a cinema record). A period of eleven and five-eighths seconds elapsed between the two exposures. Their motor speeds were very similar.

coloboma showed a reddish tinge, but no definite vessel walls were discernible. The remnant of the hyaloid sheath was practically identical with that described for twin B's left eye.

Twin B.: The optic disk of the right eye was yellowish pink, being paler on the temporal side. At the temporal border there was a small myopic scleral ring (not clearly shown in the accompanying figures). The retinal vessels emerged from the physiologic cup, which was a little undercut on the nasal border. The veins were slightly fuller than they are normally. Occupying the macular region was a conspicuous area, roughly 4 diopters in diameter, which was practically round but had an irregular border. The border was deeply pigmented, but the pigmented area varied in width in different parts of the circumference. The background was composed of the white sclera, over which were scattered lines and patches of pigment. No vessels were present in this area. The border was less clearly defined than in a typical coloboma of the choroid. In the left eye the condition was strikingly similar to that in the right eye. There was less pigment scattered over the affected area, and the border was more clearly defined by a ring of pigment. One striking exception was present, however: Extending from just below the center of

the disk forward into the vitreous about 4 diopters was a yellowish-gray translucent tube. This began as a narrow stalk, increasing slightly in diameter as it passed forward and ending in a bulbous knob about twice the diameter of the stalk. There was slight movement of the stalk with motion of the eye. This structure was interpreted as being a glial remnant from fetal life of the sheath of the hyaloid artery.

Comment.—No other case of twins similar to this has been recorded in the literature.

These identical twin girls had slightly atypical colobomas of the macula, strikingly alike in appearance in all four eyes. All four eyes were myopic, although of slightly different degree. In the left eye of each twin there was a remnant of the hyaloid sheath, and these were

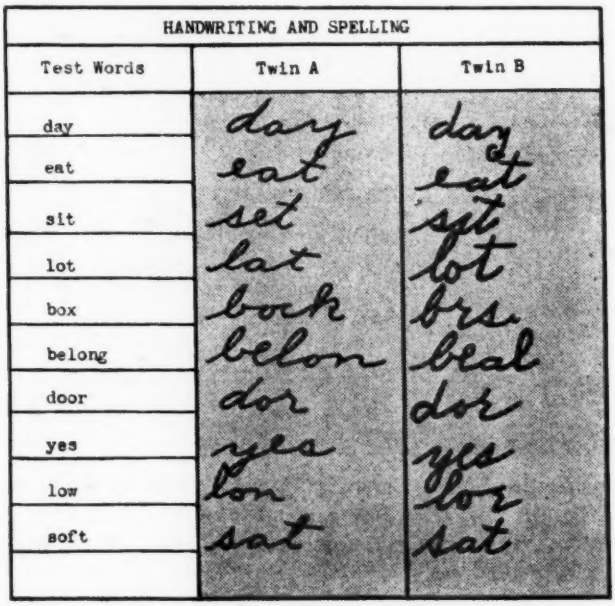


Fig. 3.—Similarities in handwriting and spelling of twins A and B.

strikingly similar. There was divergence of the right eye of one girl and of the left eye of the other, explained by the difference in visual acuity of the eyes. The girls were normal in all other respects.

In the two years during which they have been observed there has been no demonstrable change in the condition, except that the visual acuity is somewhat better as a result of wearing glasses for the correction of myopia. There has been also a diminution of the nystagmus, often seen with increasing years or through correction of a refractive error.

OCULAR PATHOLOGY AND THE PHYSIOLOGY OF TWINNING

Problems of bilateral symmetry, whether of a single eye or of a pair of eyes, are of peculiar importance in ocular pathology. Broadly

Fig. 4.—*A*, right fundus of twin A; *B*, right fundus of twin B.

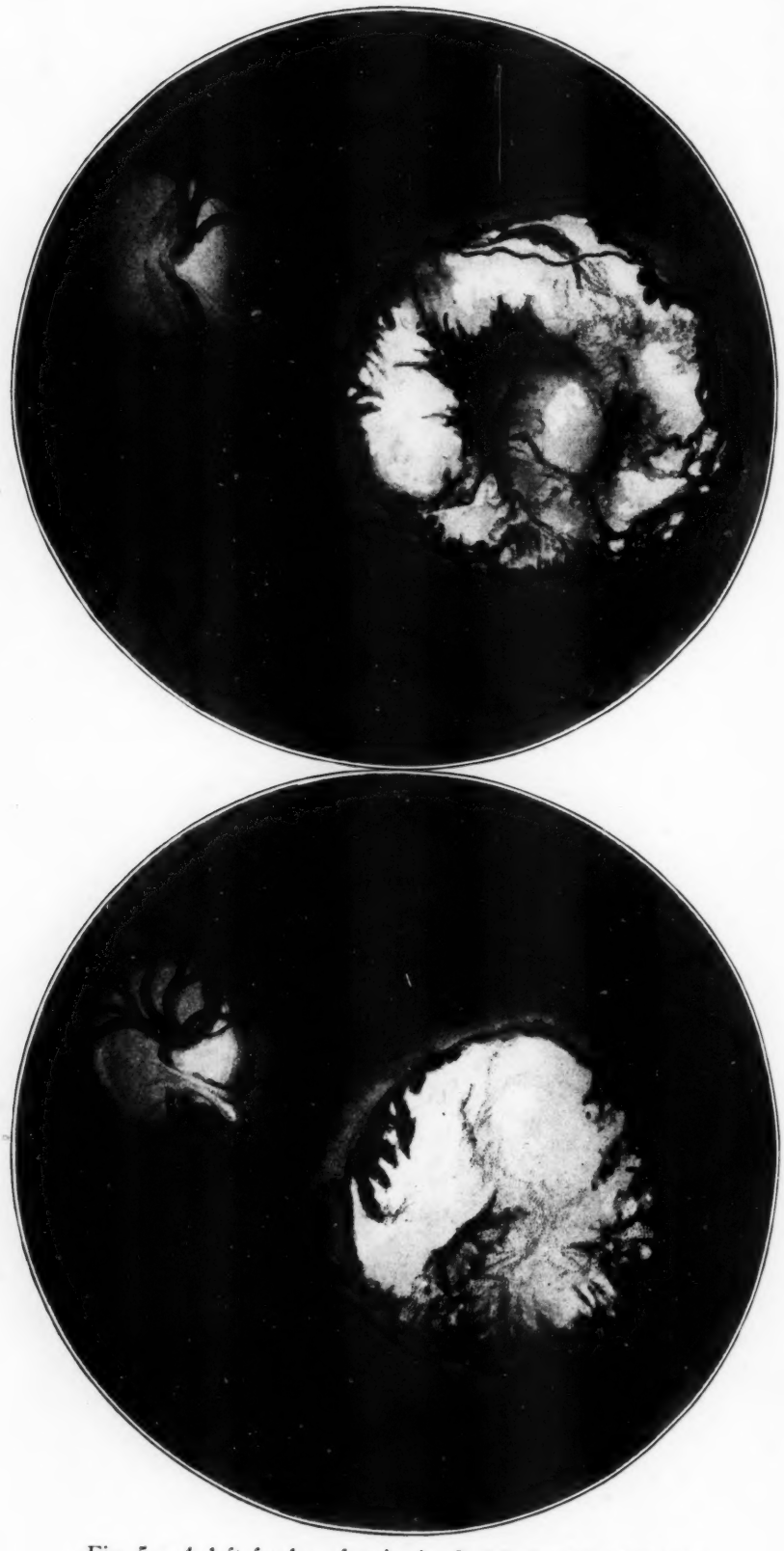


Fig. 5.—*A*, left fundus of twin A; *B*, left fundus of twin B.

conceived, twinning is a fundamental manifestation of life, "the production of equivalent structures by division." Cellular division, as such, is not twinning, but the tendency of the divided or repeated parts to assume symmetrical relations must be so regarded. This tendency is an almost universal feature of developmental mechanics. When it operates with perfect precision it produces either complete bilateral symmetry in one person or complete duplication in a pair of twins. The milder imperfections of the twinning process produce many of the asymmetries of left and right eyes with which the ophthalmologist is so familiar.

Unilateral hemihypertrophy is a rare developmental anomaly, characterized by mild gigantism of an entire half of the body. From the standpoint of twinning it may be interpreted as a minimal phase of double monstrosity. Such cases, though rare, are instructive. One of us (A. G.) in 1927 published a report of a case in which one eye definitely shared in the somatic enlargement of the corresponding side. The ophthalmoscope showed no marked difference between the right and the left fundus, except that the veins of the right fundus were fuller. There was no difference in refraction between the two eyes (fig. 6).

Cyclopia also may be regarded as an atypical twinning phenomenon, as suggested by the experiments of Adelmann on Amblystoma punctatum. At least as early as the neural plate stage, two rudiments (anlagen) for two separate eyes exist as a mosaic (Speman). These eye-forming cells, which occupy an anterior median position, expand laterally to form two optic vesicles (Stockard). On the basis of experimental extirpation and transplantation, Adelmann concluded:

> While the eye-forming potencies of the neural plate alone are higher in the median regions, the influence of the substrate is responsible for the establishment of two bilaterally situated centers of eye formation which arise as the materials expand during later stages. If the substrate fails to function normally, or the neural plate is unable to respond to its influence, the formation of a single harmoniously differentiated cyclopean eye results.

The nature of the influence of the substrate on the bilateral differentiation of the eyes is not known. It may be chemical or mechanical or both. It may involve electrochemical potentials. The main point is that developmental anomalies may be traced back to a very early stage, prior even to the stage of the neural plate, which attains a length of less than 2 mm. in the human embryo. Cyclopia, microphthalmia, absence of lids (ablepharon), coloboma of the lids (in which the cleft may divide the lid into two independent parts) and double rows of eyelashes may all be regarded as atypical variants of the twinning process.

The failure of developmental gaps to close is a frequent factor in the development of congenital ocular anomalies. The word coloboma

has come to suggest fissure. Associated with incomplete closure is delayed atresia of the blood vessels which connect the ciliary and the hyaloid vascular system in the embryo. Depending on the degree of delay and the site and the extent of the failure of closure of the fetal ocular cleft, the coloboma may involve the iris, the choroid or the disk or all three. Total failure of closure results in total coloboma.

Choroidal colobomas are classifiable as either typical or atypical. A typical coloboma results from partial or complete failure of closure

Fig. 6.—Hemihypertrophy, with enlargement of the bones and soft tissues on the right side. The right eye was larger than the left. The ophthalmoscope revealed no marked differences between the right and the left fundus, except that there was greater fulness of the veins of the right eye. The refraction of the eyes was the same.

of the fetal cleft and is clearly due to an imperfection in twinning. An atypical coloboma, according to Rones, is due to a failure of growth regulation in the margins of the embryonic optic cup. These failures also, we shall try to show, constitute an imperfection in the twinning process.

Many lesser, one might say "normal," anomalies of the eye are due to the fact that nature rarely operates with absolute perfection. Friedenwald has called attention to three forms of these anomalies: (1) a persistent hyaloid artery (patent or obliterated vascular channel), which comes out from the optic disk into the vitreous, sometimes reaching to the lens; (2) tags of connective tissue on the posterior surface of the lens (remnants of the anterior part of the embryonic hyaloid system), and (3) a persistent pupillary membrane. "These three conditions are extremely common and with the refinement of our technique, we are finding some elements of them almost universally, but they occur in varying degrees from the finest microscopic shreds of connective tissue to patent vascular beds of considerable extent."

THE GENESIS OF ATYPICAL OCULAR COLOBOMA IN TWINS

The foregoing discussion now permits a consideration of the origin of the four choroidal colobomas presented by our pair of twins. Obviously this problem involves both hereditary and epigenetic factors. In accounting for choroidal coloboma the tendency has been on the whole to seek more or less extrinsic factors. Thus, von Szily's theory suggests that notches (clefts) in the margin of the optic cup are produced by pressure from adjacent blood vessels. Ida Mann accounted for them by the intrusion or persistence of strands of mesoderm. We take our point of departure from Rones' important study, illustrated with reconstructions and histologic sections of the optic vesicle of the human embryo at stages of from 6.5 to 8.3 mm. Rones summarized his conclusions as follows:

> 1. Typical ocular coloboma results from a defective closure of the fetal ocular cleft. 2. The origin of atypical coloboma has no relationship to the fetal ocular cleft. 3. Notches occur in the margin of the embryonic optic cup due to variations of the growth energy of the margin, but normally these tend to smooth themselves out by a later equalization of growth and by the conforming pressure of adjacent tissue. 4. The persistence of these notches is due to a loss of growth energy of the tissue at this point, and the growing forward of the adjacent tissue. 5. It is not necessary to presuppose any retardation pressure from either blood vessels or connective tissue in the production of such defects. 6. The presence of connective tissue in these regions can be explained by the compensatory attempt to close the defect.

The foregoing classification draws a sharp distinction between typical and atypical colobomas, but this distinction does not necessarily involve any fundamental difference in etiology or in developmental mechanism. Both types of colobomas arise from failures in regulation of size and of bilateral symmetry. Analytic embryology conceives of such regulation as being mediated by a ground plan and by morphogenetic fields; by growth gradients, single and multiple, primary and

secondary; by dominant and local growth centers or by a varying growth potential; by "rate genes" (and also by hormones), which control the rate of the growth processes, and by "time genes," which control the time of onset of these processes.

Even though such concepts leave much in obscurity, they help to rationalize the growth phenomena at the basis of coloboma. Huxley in his volume entitled "*Problems of Relative Growth*" gave numerous quantitative and experimental data illustrating fluctuations in growth activity along a gradient in which high growth ratios were correlated with a defect of growth in adjacent regions. Even the rim of the tiny optic cup may well be subject to a series of gradients or differentials within its own circumference, because growth does not advance with a continuous front.

The circular margin of the optic cup grows forward in waves or spurts, so that the various adjacent portions spurt forward, then rest until another burst of growth energy pushes them on again. Now, if for some unknown reason, one

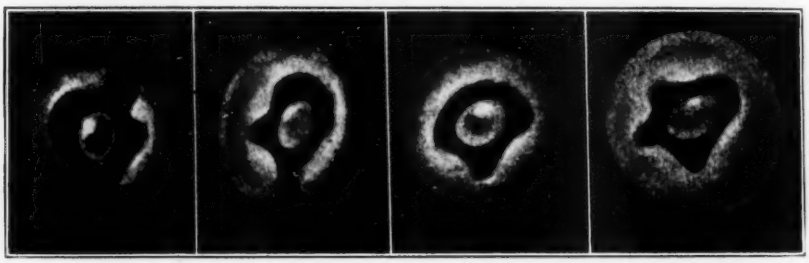


Fig. 7.—Reconstruction of the optic cup of the human embryo of 7, 6.5, 8, and 8.3 mm., respectively (after Rones).

portion of the cup margin loses this urge to grow forward, the adjacent regions will soon be far ahead, leaving a defect where the tissue has failed to keep pace. If this loss has occurred at an early stage, it will result in a very deep notch; but if it occurs later, the notch will be proportionately shallower. The resultant coloboma thus depends upon the time when this loss of energy occurs, as to whether it will involve the choroid, ciliary body, or only the iris.

THE HEREDITARY ASPECTS OF COLOBOMA

Experimental embryology draws no hard and fast line between genetic and epigenetic factors. But what is the nature of the unknown factor which causes a portion of the margin of the optic cup to lose its growth urge? Is it actually a loss of urge due to some environmental adversity, or is it a spent urge due to an intrinsic reduction of potency? And is the time when this loss of energy occurs determined by extrinsic or by intrinsic factors?

The remarkable correspondence in the four colobomas of our twins now demands explanation in the light of these questions. If a single "environmental" adversity caused the notching of the optic cup, it must have operated coincidentally within an extremely brief and critical interval on four rapidly organizing structures which simultaneously reached identical levels of maturity. This is an excessively remote possibility. It is still more unlikely that four defects of as many choroids, so similar in size, outline, position and pigmentation, could have occurred at different times in consequence of four separate moments of infection, of irritation or of damage neatly directed at each of the four eyes. It is, however, conceivable that the original single zygote or the constitutive factors in the twin embryos, which already held the hereditary determiners of all four eyes, held also the specific factors (or mutations) which delimited the development of the choroid. Similar specific factors would likewise account for the persisting remnant of the left hyaloid artery and for the correspondences of the shape and refraction of the four eyes. These eyes were derived from a single cell with one genetic constitution.

The hereditary nature of the type of coloboma under discussion is strongly suggested by the very fact that it occurred with such striking reduplication in a pair of monozygotic twins. Although both parents in the present instance were free from ocular defect, a disturbance of the fundus in the mother's kin was suggested. Unfortunately we were unable to define or to corroborate the details.

Clausen (according to Sorsby) reported an instance of bilateral coloboma of the macula in a brother and sister. Moreover, two sons of the brother and two daughters of the sister were likewise affected. Schott reported the same condition in two daughters and a paternal aunt. Davenport reported an instance in a mother and son.

Further support for hereditary interpretation has been furnished by reports of several cases of familial coloboma of the iris and related anomalies by Hessin, Risley, Libby, Müller-Kannberg, Tobias, Snell, Shannon, Loeb, Ring and Velhagen. Snell included a chart which showed twelve cases of bilateral coloboma of the iris occurring in five successive generations (fig. 8).

Sorsby recently reported on a very rare familial group in which bilateral coloboma of the macula occurred in a mother and in five of her seven children. The coloboma was of the pigmented variety and was associated with special dystrophy of the hands and feet. Absence of nails, especially of the index fingers and great toes, stunting or absence of phalanges and a tendency to bifurcation of the thumbs and the great toes were noted.

DEVELOPMENTAL CORRESPONDENCE IN THE PATHOLOGIC CONDITIONS OF THE EYES OF TWINS

The literature on pathologic conditions of the eyes of twins has in recent years reached considerable proportions. These studies strongly suggest that twins can be more systematically used for the investigation of problems of etiology and treatment by the experimental method of co-twin control. This method consists essentially in subjecting one twin to precisely known stimuli or procedures, reserving the highly similar co-twin as a control and check on the observations made (Gesell and Thompson, 1929).

The evidence is overwhelming that correspondence and resemblances in ocular conditions are much greater in monozygotic than in dizygotic twins. J. A. Wilson has shown in his series of cases that

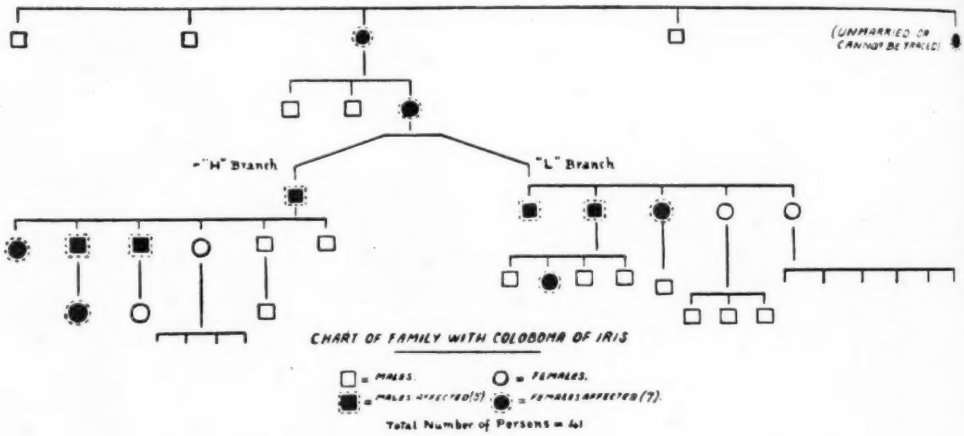


Fig. 8.—Family chart, including twelve persons with bilateral coloboma of the iris (after Snell).

paired siblings (single-born brothers and sisters) exhibit much less similarity with regard to ametropia and strabismus than do twins, even when no distinction is made between identical and fraternal twins.

Likewise, Rife made comparisons of fifty pairs of siblings and fifteen pairs of identical twins, with respect to pigmentation of the iris. He found in the twin pairs that the pigmentation and its distribution showed as great similarity as is observed between the right and the left eye of one person. Indeed, he concluded that "similar iris pigmentation is a far more reliable criterion of monozygosity than similar finger patterns."

Heinonen reported three interesting instances of ocular correspondence in indubitably monozygotic twins. In one pair of boys the identity included noses as well as eyes. In both boys there was distinct

deviation of the nose to the right. Even this deviation, so suggestive of an external influence, was evidently produced by genetic factors. The third case reported by Heinonen is especially noteworthy. Three eyes, namely, two left eyes and one right eye, of a pair of twins were remarkably similar, with identical corneal refraction and axial length. Designating the twins A and B, we obtain the following equations: Left eye, twin A = left eye, twin B = right eye, twin A (for refraction). Left eye, twin A = left eye, twin B = right eye, twin B (for axial length). In innumerable physical and psychologic characters these twins were identical. Even their handwriting was almost indistinguishable. The specific disparity in the fourth eye may be one of those exceptions which prove the rule of hereditary determination. Heinonen pointed to the American studies of *Drosophila* and suggested that the asymmetry may have arisen from a slight inequality in the original partitioning of the threads of chromatin which placed several chromomeres on the "wrong" side.

Halbertsma made similar observations on the corneal curvature, astigmatism and refraction of twelve pairs of monzygotic and two pairs of dizygotic twins. All the monozygotic twins showed complete similarity of the eyes with respect to corneal curvature, astigmatism and refraction. He noted that the data concerning these three characteristics point strongly to hereditary factors. He pointed out, however, that even though these characteristics are inherited they may combine in a different manner in different persons, leading to different end-results, as expressed in the total refraction.

Weitz reported on forty-five pairs of monzygotic twins and gave special data concerning slight ocular differences for several pairs. He found the usual degree of resemblance and a significant similarity in the interocular distance. His study was noteworthy because it was not limited to the eyes but included numerous data on other organs and a statistical table of thirty comparative physical measurements.

Pillat reported on an interesting pair of Chinese twin boys, aged 8 years, in whom ordinary bilateral resemblances were associated with a striking array of homolateral mirror-image resemblances. In each boy the right eyebrow had markedly more abundant hair and the lashes of both eyes were remarkably alike in color, length and direction. The configuration of the upper lids, the location of the tear ducts and the size and course of the epicanthic fold were highly similar, and likewise the degree and planes of the corneal astigmatism. But in the following items the resemblance was of the mirror-image type: (1) convergent strabismus (twin A, left; twin B, right); (2) refraction (twin A, a greater degree in the left eye; twin B, in the right); (3) diameter of the cornea (greatest horizontally in the fixating eye);

(4) corneal refraction; (5) visual acuity, and (6) atypical optic disk in the deviating eye. The hereditary background of these characteristics was further suggested by the fact that the twins shared the following congenital anomalies with their mother: convergent strabismus, combined with myopia and myopic astigmatism, and one atypical optic disk.

In a brief but comprehensive article, supported by a bibliography of one hundred and twenty titles, McFarland and Meade discussed the genetic origin of tumors in homologous (monozygotic) twins. The authors expressed the belief that it is remarkable that they were able to find reports of cases of a dozen different kinds of tumor occurring simultaneously and symmetrically in a dozen different parts of the body in monozygotic twins. They found no instance in which only one twin had a tumor. Ocular melanoma, retinblastoma and even leukemia and Hodgkin's disease have each been reported as occurring simultaneously in monozygotic twins.

Waardenburg, of Arnheim, Netherlands, in 1930 made a thorough review of the literature on twins, with special reference to problems of refraction. He assembled the refractive data for one hundred and thirty-seven pairs of monozygotic twins and for fifty-five pairs of dizygotic twins. He found only nine pairs of monozygotic twins in which there was any considerable discordance in one or two of the four eyes with respect either to astigmatism or to total refraction. In a valuable critical discussion Waardenburg emphasized the importance of research on twins as a key to a better understanding of the origin and variability of myopia.

Particularly noteworthy is the monograph by Huber, embellished with one hundred and fifty-eight illustrations, including photographs not only of the twenty-three pairs of twins but of the fundus of each of their ninety-two eyes. Careful comparative determinations were made for about twenty items. In several cases detailed similarities in the teeth also were demonstrated by means of dental casts. Most remarkable was the consistent resemblance of monozygotic twins in the number, distribution and branching of the retinal blood vessels. The author also stressed similarities in the form and color of the physiologic excavation and the choroidal and scleral rings. The study was replete with impressive resemblances.

Such research on twins has significance not only for ophthalmology but also for broader aspects of human biology. The possibilities of this research have been demonstrated, but they are far from exhausted. Dr. Alfred Vogt, director of the University Ophthalmologic Clinic in Zurich, for example, pointed out that investigations thus far have dealt chiefly with congenital anomalies and have left untouched important

problems of senescence and senility.[1] These problems, too, can be illuminated by the study of twins.

We have compiled a relatively complete annotated list of the studies dealing with ocular correspondence and ocular pathology in twins.[2] These studies are classified into three groups: (1) comparative studies of groups of twins, (2) studies of ametropia in individual pairs of twins, and (3) studies of pathologic conditions of the eyes in individual pairs of twins.

1. COMPARATIVE STUDIES OF GROUPS OF TWINS

BECKERSHAUS.—*Twelve pairs of monozygotic twins.*

The following inherited characteristics were observed as similar: the color, placement and texture of the hair, the color of the skin, the structure and color of the iris and the size of the pupil. Refraction and astigmatism, both of the cornea and of the entire optical system, showed a variation of 1 diopter at the most. Pigmentation of the hair and the iris and also freckles were ascribed to hereditary transmission.

HALBERTSMA.—*Twelve pairs of monozygotic twins and two pairs of dizygotic twins.*

In the monozygotic twins there was greater conformity between the members of a pair as regards both the ocular and the monocular characteristics than in the dizygotic twins. Among the ocular characteristics the axis system of the corneal meridian showed the least variation with the strongest as well as the weakest refraction; in several cases of monozygotic twins this characteristic was directly inherited in one or both eyes from one or both parents. The axis system must be considered as an inherent hereditary element.

HUBER.—*Sixteen pairs of monozygotic twins and seven pairs of dizygotic twins ranging in age from 6 to 34 years.*

Twelve different tests and measurements were made, and the eyegrounds were photographed. The monozygotic twins showed marked similarities in the following characteristics: corneal and total refraction (maximum difference, 1.5 diopters); corneal astigmatism (maximum difference, 0.5 diopter); visual acuity; intensity of the color of the iris; distribution of pigmentation in the iris;

1. Since this statement was written, Dr. Vogt has contributed a remarkable study on the hereditary determination of senile characteristics, as observed in the eyes of nineteen pairs of monozygotic twins, from 55 to 81 years of age (Schweiz. med. Wchnschr. **65**:576, 1935). This study was reported in detail, with photographs, in *Archiv der Julius Klaus Stiftung für Vererbungsforschung und Sozialanthropologie* in 1935. He found almost identical correspondence in the deterioration of the cornea, lens and retina in each pair of twins. Especially striking were the detailed similarities of changes in the intimate structure of the lens. There was remarkable agreement also in the wrinkling of the forehead, mouth and eyelids.

2. The monographs by Beckerhaus, Gesell (1931), McFarland and Meade, Mann, Siemens and Waardenburg offer extended bibliographies. Bibliographies and reports of investigations of twins may be found also in the *Proceedings of the Maxim Gorky Medico-Biological Research Institute* (the third volume was published in 1934).

the pupillary margin; the opening and folds of the lids; the eyebrows; congenital clouding of the lens; embryonal cataract; the form and color of the optic disk and physiologic excavation; the choroidal and scleral rings; the macula, and the form and position of the teeth. The dizygotic twins showed considerable differences in all these items.

JABLONSKI.—*Fifty-two pairs of monozygotic and dizygotic twins.*

The following items were measured: total refraction, total astigmatism, corneal refraction and corneal astigmatism. Data were summarized in comparative curves for individual subjects and for twins. The results showed a significantly greater similarity among monozygotic pairs.

RIFE.—*Fifteen pairs of monozygotic twins and five pairs of dizygotic twins.*

One pair of monozygotic twins were color blind for red and green. In monozygotic twins the pigmentation and its distribution showed as great a similarity as was observed between the right and the left eye of one person. Judging from these observations, pigmentation of the iris alone is sufficient to prove or disprove monozygosity. In dizygotic twins intrapair comparisons indicated that the individuals vary as greatly as do ordinary siblings; so the age factor would not seem to detract greatly from the value of the color of the eye as a criterion of monozygosity.

SIEMENS.—*Thirty pairs of twins, mostly monozygotic.*

The studies showed, with a few exceptions, correspondence in defects and anomalies of the eyes and ears, including color blindness, ophthalmia (in conjunction with similar unilateral migraine) and ulcus corneae.

STERN.—*Nine pairs of monozygotic twins and three pairs of dizygotic twins.*

The eyegrounds were photographed and compared. The shape and size of the disk, the color of the fundus and the physiologic excavation were the same in the corresponding eyes, whether the origin was from one or from two ova. Examination of the fundus was not an aid in deciding whether the origin was from one or from two ova (compare with Huber's report).

WAARDENBURG.—*One hundred and thirty-seven pairs of monozygotic twins and fifty-five pairs of dizygotic twins.*

The developmental conditions which existed in the two groups, especially in the identical pairs in comparison with the fraternal pairs, may have been different. Nine cases of asymmetry in monozygotic twins were cited. Mirror symmetry in identical pairs was not considered as a true deviation. It was shown that there was a variation in refraction in only 6.5 per cent of the monozygotic pairs, while it was of common occurrence in the dizygotic pairs. In total refraction 90 per cent of the monozygotic twins had a difference of less than 1 diopter. Dizygotic twins had a difference of up to 9 diopters.

WEITZ.—*Forty-five pairs of monozygotic twins.*

The author cited numerous genotypical similarities, including color of the iris, pterygium, cataract, scleral ring, papillary conus, astigmatism and hyperopia. He stated that refraction may be influenced by such paratypical factors as a developmental conformation of the skull which affects the orbits.

WENINGER.—*Twelve pairs of monozygotic twins.*

This unusual study was limited to the soft tissue accessories of the eyes: the size and disposition of the lids; the shape and size of the palpebral opening; the density and direction of the hair of the eyebrows and eyelashes, and the definition of the folds and sulci. An amazing degree of concordance was demonstrated for numerous details and even for asymmetries in these details. Hereditary parent-twin similarities are cited. The author suggested that these findings are of significance in physical and racial anthropology.

J. A. Wilson.—*Twelve pairs of monozygotic and dizygotic twins, ranging in age from 6 to 12 years.*

Ametropia and strabismus were present in similar degree in 25 per cent of the pairs and in approximately similar degree in 33.5 per cent. There was more than 1 diopter of difference in 41.5 per cent. In the first group five of the six children were squinters; in the second group four of the eight children were squinters, and in the third group one of the ten children was a squinter.

2. STUDIES OF AMETROPIA IN INDIVIDUAL PAIRS OF TWINS

Black.—*A pair of monozygotic twins, 28 years of age.*

There was marked hyperopia. Each gave a history of convergent concomitant squint in childhood. When glasses were worn the squint disappeared. Each twin had an amblyopic eye, but it was the right eye of one girl and the left eye of the other. In each, however, it was the eye with the higher degree of ametropia. The refraction was typical of that of a high grade hyperopia with astigmatism and was very similar in the two women.

Bunce and Dougherty.—*A pair of monozygotic twins, 27 years of age.*

One twin had convergent strabismus, with amblyopia of the left eye, while the other had divergent strabismus, with amblyopia of the right eye. This mirror effect of a convergent defect in monozygotic twins is a very rare finding.

Emerson.—*A pair of twins.*

Ametropia was equal in the two twins. After the instillation of homatropine vision in the right eye of twin A was 20/15 with —1.00 sph. ⌒ —1.00 cyl., axis 95°; in the left eye vision was 20/15 with —1.00 sph. ⌒ 1.00 cyl., axis 85°. In the right eye of twin B vision was 20/15 with —1.00 sph. ⌒ —0.75 cyl., axis 90°; in the left eye vision was 20/15 with —1.00 sph. ⌒ —0.75 cyl., axis 90°.

Heinonen.—*Three pairs of monozygotic twins.*

Ametropia was marked in one pair. Refraction was alike in the two brothers. The ametropia in the right eye of twin A was caused by an abnormally long axis; that of twin B, by too strong refraction of light in the obliquely horizontal meridian. An interesting discussion of this asymmetry was given.

Landolt.—*A pair of twins, 30 years of age.*

The ametropia was equal in these twins. In the right eye of twin A vision was 2 with +1.50 sph. ⌒ —0.50 cyl., axis 170°; in the left eye vision was 2 with +1.25 sph. In the right eye of twin B vision was 2 with + 1.50 sph. ⌒ —0.50 cyl., axis 180°; in the left eye vision was 2 with +1.25 sph.

Pillat.—*A pair of monozygotic twins, 4 months of age.*

There were astigmatism and internal strabismus. The astigmatism and the axis in the corresponding eyes of the two individuals were equal. Both had internal strabismus, and the eyes of one were the mirror image of those of the other, one child fixating with the right eye and the other with the left. In each the deviating eye was more hyperopic than its fellow; it was amblyopic, and it had a larger cornea, with a corresponding radius of curvature and corneal refraction and a corresponding conus. The eyebrow, lids, epicanthal fold and tear duct were similar in the two deviating eyes.

3. STUDIES OF PATHOLOGIC CONDITIONS OF THE EYES IN INDIVIDUAL PAIRS OF TWINS

Benedict.—*A pair of monozygotic twins, 4 years of age.*

A retinoblastoma was present in a similar location in the left eyes of these twins. One child died four months after operation. The other child, who had

tumors in both eyes, recovered; but when she was 10 a posterior cortical cataract developed.

DANFORTH.—*A pair of monozygotic twins.*

Night blindness was marked, neither twin being able to walk about at night, although both had a good sense of direction.

GLOVER.—*A pair of monzygotic twins, 16 years of age.*

Both twins had a congenital amblyopia. Refraction was identical in their right eyes, and the sphere for the left eyes was the same. Both had bluish sclerotics, as well as a 90 degree oval appearance of the disks. With the right eye each could read the finest type. With the left eye one twin could barely see the largest reading type, one letter at a time; the other twin could read only the three largest lines.

KIEHLE AND PUGMIRE.—*A pair of monozygotic twins, 6 years of age.*

There was unilateral buphthalmos in opposite eyes of the twins, which had caused visible enlargement when they were 3 months old.

NETTLESHIP.—*A pair of monozygotic twins.*

Red-green color blindness was noted in one twin; but the co-twin had normal color vision. The difference in the twins was not ascribed to any difference in hereditary factors.

RYCHENER.—*A pair of monozygotic twins, 16 years of age.*

There was compound hyperopic astigmatism, with normal vision in each right eye and amblyopia in each left eye. In twin A the left eye diverged 10 diopters under cover, and there was no binocular vision. In twin B binocular vision was present, with esophoria of 4 degrees. The fundus was entirely normal, but all four optic disks showed high central branching of the vessels, with a profuse colloid deposit beneath them, entirely covering all other landmarks of the disk and projecting slightly beyond the normal limits of the disk, with an elevation of 3 or 4 diopters above the retina.

SILCOCK.—*A pair of monozygotic twins.*

There was melanotic sarcoma of the eyeball. One twin had a tumor of the eyeball, which developed about a year before the birth of a daughter, who had a similar tumor at the age of 20. The other twin died of multiple tumors at the age of 40.

SIVELLI.—*A pair of monozygotic twins, 6 years of age.*

There was bilateral congenital horizontal nystagmus in each twin, which apparently did not arise from any defect of the visual apparatus and which was ascribed to constitutional factors.

S. A. K. WILSON AND J. M. WOLFSOHN.—*A pair of monozygotic twins.*

Both twins showed congenital nuclear ophthalmoplegia. There was marked bilateral ptosis with overaction of the frontalis muscles. No upward or downward movement of the eyeballs could be elicited, and there was no movement of convergence in the eyes.

GENERAL SUMMARY

An instance of remarkable duplication of bilateral coloboma in a pair of twin girls, aged 12 years, is reported in detail, with drawings of the fundi of the four eyes.

Associated resemblances in physical and mental characteristics are defined and illustrated.

The physiology of twinning is discussed in relation to the etiology of ocular conditions, including the genesis of coloboma.

The hereditary factors in macular coloboma are indicated.

In a tabular summary and in a bibliography the literature on ocular correspondence in twins is assembled, with annotations and critical comment.

The importance of further investigation of ocular pathology by means of twins and by the method of co-twin control is suggested.

BIBLIOGRAPHY

Adelmann, H. B.: The Embryological Basis of Cyclopia, Am. J. Ophth. **17**:890, 1934.

Beckershaus, F.: Ueber eineiige Zwillinge, Ztschr. f. Augenh. **59**:264, 1926.

Benedict, W. L.: Retinoblastoma in Homologous Eyes of Identical Twins, Arch. Ophth. **2**:545 (Nov.) 1929.

Black, M.: Twins with High Hyperopia, Am. J. Ophth. **7**:375, 1924.

Brav, A.: Bilateral Macular Coloboma, Am. J. Ophth. **17**:1151, 1934.

Bunce, A. H., and Dougherty, M. S.: Diabetes Mellitus in Twins, J. A. M. A. **92**:52 (Jan. 5) 1929.

Danforth, C. H.: Resemblances and Differences in Twins, J. Hered. **10**:399, 1919.

Dickinson, H.: Am. J. Ophth. **17**:748, 1934.

Emerson, L.: Equal Ametropia in Twins, Am. J. Ophth. **7**:966, 1924.

Folk, M. L.: Histopathology of Coloboma of the Choroid and Optic-Nerve Entrance, Am. J. Ophth. **17**:1126, 1934.

Friedenwald, J. S.: The Pathology of the Eye, New York, The Macmillan Company, 1929.

Gesell, A.: Hemihypertrophy and Mental Defect, Arch. Neurol. & Psychiat. **6**:400 (Oct.) 1921.

Mental and Physical Correspondence in Twins, Scient. Monthly **14**:304, 1922.

Hemihypertrophy and Twinning: A Further Study of the Nature of Hemihypertrophy with Report of a New Case, Am. J. M. Sc. **173**:542, 1927.

Behavior Resemblance in Identical Infant Twins, Eugenical News **14**:72, 1929.

The Developmental Psychology of Twins, in Murchison, Carl: A Handbook of Child Psychology, Worcester, Mass., Clark University Press, 1931, p. 158.

——and Thompson, H.: Learning and Growth in Identical Infant Twins: An Experimental Study by the Method of Co-Twin Control, Genetic Psychol. Monogr. **6**:1, 1929.

Glover, L. P.: Amblyopia in Identical Twins, Am. J. Ophth. **15**:140, 1932.

Halbertsma, K. T. A.: Observations on the Corneal Curvature, Astigmatism and Refraction in Several Pairs of Twins Belonging to the Same Family, Arch. f. Ophth. **123**:632, 1930.

Heinonen, O.: Ueber die Refraktion bei eineiigen Zwillingen, speziell in Hinsicht der asymmetrischen Fälle, Acta ophth. **2**:35, 1924.

Hessin: Family Coloboma in Iris and Choroid, abstr., Klin. Monatsbl. f. Augenh. **52**:329, 1914.

Huber, A.: Ophthalmologische Untersuchungen an eineiigen und zweieiigen Zwillingen, Arch. d. Julius Klaus Stiftg. f. Vererbsforsch. **6**:41, 1931.

Huxley, J. S.: Problems of Relative Growth, New York, Lincoln MacVeagh, The Dial Press, 1932.

Jablonski, W.: Ein Beitrag zur Vererbung der Refraktion menschlicher Augen, Arch. f. Augenh. **91**:309, 1922.

Jackson, E.: Coloboma in the Eye, Am. J. Ophth. **17**:540, 1934.

Kiehle, F. A., and Pugmire, C.: Buphthalmos in Identical Twins, Arch. Ophth. **12**:751 (May) 1934.

Landolt, M.: Equal Ametropia in Twins, Am. J. Ophth. **7**:723, 1924.

Libby, G. F.: Heredity in Relation to the Eye, Ophthalmology **9**:165, 1913.

Loeb, C.: A Case of Hereditary Bilateral Upward Coloboma of the Iris, with Remarks on Hereditary Blindness, Ann. Ophth. **26**:573, 1917.

McFarland, J., and Meade, T. S.: Genetic Origin of Tumors Supported by Their Simultaneous and Symmetrical Occurrence in Homologous Twins, Am. J. M. Sc. **184**:66, 1932.

Mann, I. C.: The Development of the Human Eye, London, Cambridge University Press, 1928.

May, C. H.: Manual of the Diseases of the Eye, ed. 8, New York, William Wood & Company, 1914.

Müller-Kannberg: Zur Casuistic der Opticus-Colobome, Klin. Monatsbl. f. Augenh. **32**:173, 1894.

Neff, F. C.: Exophthalmic Goiter in Identical Twin Girls, J. Pediat. **1**:239, 1932.

Nettleship, E.: Some Unusual Degrees of Colour-Blindness, Tr. Ophth. Soc. U. Kingdom **32**:309, 1912.

Pillat, A.: Zur "Aehnlichkeitsdiagnose" der Augenmerkmale bei eineiigen Zwillingen und über "Spiegelbildsymmetrie" gewisser Merkmale, Ztschr. f. Augenh. **71**:35, 1930.

Rife, D. C.: Genetic Studies of Monozygotic Twins: Finger-Patterns and Eye-Color as Criteria of Monozygosity, J. Hered. **24**:406, 1933.

Ring, G. O.: Concerning Coloboma of the Iris in Association with Congenital Cataract, Ophth. Rec. **26**:113, 1917.

Risley, S. D.: Aniridia with Interesting Family History, Tr. Coll. Physicians Philadelphia **37**:397, 1915.

Rones, B.: The Genesis of Atypical Ocular Coloboma, Am. J. Ophth. **17**:883, 1934.

Rychener, R. O.: Identical Twins with Hyperopia, Amblyopia ex Anopsia, and Colloid Deposits in Optic Disks, Am. J. Ophth. **14**:685, 1931.

Schmidt: Klin. Monatsbl. f. Augenh. **80**:553, 1928.

Shannon, C. E. G.: Two Cases of Congenital Iris Coloboma, Ophth. Rec. **26**:398, 1917.

Siemens, H. W.: Die Zwillingspathologie, Berlin, Julius Springer, 1924.

Silcock, A. Q.: Hereditary Sarcoma of the Eyeball in Three Generations, Brit. M. J. **1**:1079, 1892.

Sivelli, P.: Nistagmo orizzontale congenito in una coppia di gemelli, Riv. di clin. pediat. **29**:648, 1931.

Snell, S.: Coloboma of the Iris in Each Eye, Occurring in Five Generations, Tr. Ophth. Soc. U. Kingdom **28**:148, 1908.

Sorsby, A.: Three Groups of Unusual Fundus Disturbances, Proc. Roy. Soc. Med. **27**:694, 1934.

Speman, H.: Ueber experimentell erzeugte Doppelbildungen mit cyclopischem Defekt, Zool. Jahresb. (supp.) **7**:429, 1904.

Stern, H. J.: A Comparative Investigation of the Ocular Fundi of Twins, Klin. Monatsbl. f. Augenh. **90**:215, 1933.

Stockard, C. R.: An Experimental Study of the Position of the Optic Anlage in Amblystoma Punctatum, Am. J. Anat. **15**:253, 1913.

Tobias, G.: Ein Beitrag zur Vererbungsmöglichkeit erworbener Augendefekte, Klin. Monatsbl. f. Augenh. **49**:212, 1911.

Velhagen: Atypisches Coloboma Iridis congenitum beim Vater; Aniridia congenita bei den Kindern, München. med. Wchnschr. **70**:469, 1923.

Waardenburg, P. J.: Refraktion und Zwillingsforschung, Klin. Monatsbl. f. Augenh. **84**:593, 1930.

Weitz, W.: Studien an eineiigen Zwillingen, Ztschr. f. klin. Med. **101**:115, 1924.

Weninger, J.: Ueber die Weichteile der Augengegend bei erbgleichen Zwillingen, Anthrop. Anz. **9**:57, 1932.

Wilson, J. A.: Twins with Eye Defects: Ametropia and Strabismus, Brit. J. Ophth. **16**:421, 1932.

Wilson, S. A. K., and Wolfsohn, J. M.: Organic Nervous Disease in Identical Twins, Arch. Neurol. & Psychiat. **21**:477 (March) 1929.

AN INSTRUMENT FOR MEASURING DYNAMIC SPEED OF VISION, SPEED OF ACCOMMODATION AND OCULAR FATIGUE

C. E FERREE, PH.D.
AND
G. RAND, PH.D.
BALTIMORE

There are two types of test for speed of vision: a static test and a dynamic test. In the static test the eyes fixate and accommodate for a given selected distance, and the test object is exposed at that distance for the minimum time needed for its discrimination. Such conditions test only the speed of reaction of the sensorium. They give no information as to the motor functions of the eyes and the effectiveness of their coordination for the purpose of seeing. In the dynamic test for speed of vision, on the other hand, the eyes are required to shift their regard from one object to another or to a series of objects and to discriminate them in turn during the time or times of exposure. These conditions test not only the speed of reaction of the sensorium but also the oculomotor facility and efficiency.

So far as the discrimination of an object is concerned, the static test is sensitive for such purposes as a determination of the effect of intensity or color of light or, in general, of such factors as affect acuity and visibility. It can also be used for determining the time threshold of sensation and the course of the rise of sensation from minimum to maximum and for making other sensory determinations in which time of exposure is the important factor. The dynamic test, in addition to testing oculomotor facility and efficiency, is of value for determining individual fitness for different types of work and is especially valuable for studying in a given person general and ocular fatigue and recovery, as well as all conditions, ocular and general, including pathologic disturbances, that affect muscular coordination and efficiency. The various uses and applications of this test will be discussed in greater detail later in the paper.

We have devised instruments for making both the static test and the dynamic test. Work in which the former instrument was used has

From the Research Laboratory of Physiological Optics.

been described in previous papers.[1] Our purpose in this paper is to describe an instrument for making the dynamic test.

DESCRIPTION OF THE INSTRUMENT

The device for making the dynamic test of speed of vision has, in general, the following features: two near test objects suitably located on either side of the median plane of the observer and one far test object located in the median plane, all three of which are at the same vertical level and have a provision for an objective check on the judgment; an apparatus for the exposure of the test objects in the serial order of near, far and near; a means of driving the apparatus at suitable constant rates of speed, and a provision for the remote control of the far test object from the position of the examiner.

A view of the instrument designed only to represent the general test situation was published in the ARCHIVES in connection with a report on a study of the dynamic speed of vision of aviators by Lieutenant-Commander C. J. Robertson of the United States Naval Hospital.[2] This illustration, which showed only the head-rest at the position of the observer, the front of the exposure apparatus and the far test object, gave none of the details of construction of the instrument and will not be reproduced here. Dr. Robertson's paper contained no description of the apparatus. Figure 1 of the present paper is a close-up view of the exposure apparatus, which shows the back of the near test cards, the driving mechanism and the exposure disks so positioned in their circle of rotation as to show the details of their construction.

The exposure apparatus, which might be called a compound rotary tachistoscope, was devised to meet the needs of the test. It is furnished with four disks located in front of the near test objects and as near as possible to them: a pair of large disks, *A* and *D*; a single disk of smaller diameter, *B*, and a single disk of intermedate diameter, *C*. These disks were cut from hard sheet aluminum, no. 20 B and S gage, as

1. Ferree, C. E., and Rand, G.: The Effect of Variations in Intensity of Illumination on Acuity, Speed of Discrimination, Speed of Accommodation and Other Important Eye Functions, Tr. Am. Ophth. Soc. **19**:259, 1921; The Effect of Variation of Visual Angle, Intensity and Composition of Light on Important Ocular Functions, Tr. Illum. Engin. Soc. **17**:69, 1922; Further Studies on the Effect of Composition of Light on Important Ocular Functions, ibid. **19**:424, 1924; Flicker Photometry and the Lag of Visual Sensation, Am. J. Psychol. **35**: 208, 1924; Intensity of Light and Speed of Vision Studied with Special Reference to Industrial Situations, Tr. Illum. Engin. Soc. **22**:79, 1927; **23**:507, 1928; Size of Objects in Relation to Their Visibility and to the Rating of Vision, Arch. Ophth. **4**:37 (July) 1930; Visibility of Objects as Affected by Color and Composition of Light, Personn. J. **9**:475, 1931; **10**:108, 1931; The Problem of Late Afternoon Lighting, Arch. Ophth. **7**:558 (April) 1932.

2. Robertson, C. J.: Measurement of Speed of Adjustment of Eye to Near and Far Vision, Arch. Ophth. **14**:82 (July) 1935.

shown in figure 1. The inner portion, with a radius of 6.5 cm., is continuous through 360 degrees, and the outer portion extends through 180 degrees. The breadth of the outer zone of disks *A* and *D* is 22.5 cm.; that of the outer zone disk *C*, 20.5 cm., and that of the outer zone disk *B*, 14.5 cm. Disk *A* is permanently pinned to the axle; disks *B*, *C* and *D* are adjustable. The diameter of disks *A* and *D*, when in position, is sufficient to cover all three test objects—the two near test objects, one on the right and one on the left of the median plane of the observer, and the far test object in the median plane; that of disk *B* is sufficient to cover only the near test object on the left, and that of disk *C*, to cover the far test object. When the disks are at rest prior to beginning the

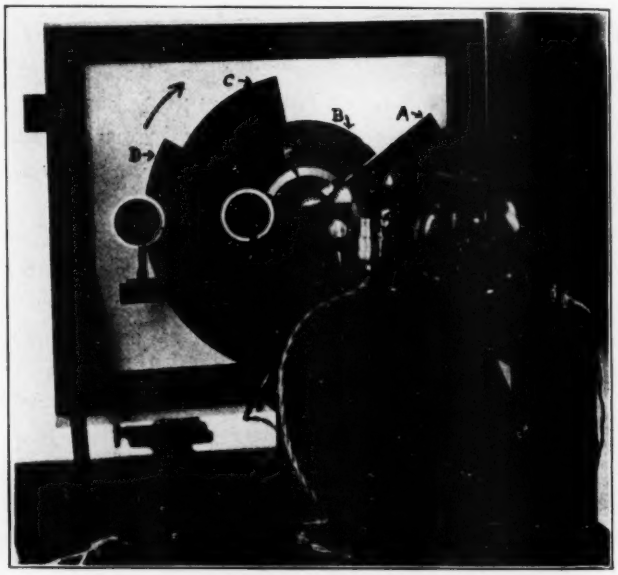


Fig. 1.—Close-up of exposure apparatus, showing the driving mechanism, the backs of the near test cards, and the exposure disks so positioned in their circle of rotation as to give details of their construction.

test, disk *A* covers the three test objects. On this disk, directly in front of the near test object on the left, is a cross for the control of fixation and the adjustment of accommodation. As the disks turn, this test object is exposed and then is cut off from the observer's view by disk *B*. The eyes then diverge and swing to the right to see the far test object in the median plane. This exposure is terminated by the intervention of disk *C*. Continuing their excursion, the eyes converge and swing still farther to the right to see the second near test object, the exposure of which is terminated by the intervention of disk *D*. Thus the aperture between disk *A* and disk *B* provides for the exposure of the near test object on the left; that between disk *B* and disk *C*, for the

exposure of the far test object, and that between disk *C* and disk *D*, for the exposure of the near test object on the right.

Disk *A* is provided with a graduated semicircular scale, which is fastened along the edge of the inner portion of the disk, as shown in figure 1, and disks *B*, *C* and *D*, with raised, narrow pointers having a straight edge flush with one radial edge of each disk, which are so positioned that when the disks are assembled on the axle the pointers travel over the scale. On this scale are three sets of divisions, one in terms of degrees of open sector and the other two in units of time corresponding to the two speeds of rotation of the disks provided for in the driving mechanism.

Fig. 2.—Device for a quick and easy means of adjusting the movable sector in a sectored disk and holding it firmly in any given setting.

The disks are mounted on an axle which turns in bearings at the top of a heavy Y-shaped support. Disk *A*, as has already been stated, is pinned to the axle in such a position that when it is at rest before the beginning of the exposure it covers all three test objects. Disks *B*, *C* and *D* are free to turn about the axle and when adjusted for a given value of exposure are clamped in position by means of a nut and washer. This means of adjusting the position of the disks is the one inconvenient feature of the apparatus. Because of this inconvenience, we have, since this model was constructed, devised a quick and easy means of changing the value of the open sector of the disks. This device as applied to a single pair of disks is shown in figure 2. One of the

disks is pinned to the axle. Also fastened to the axle is a bench or support for the worm member of a worm-gear. The other disk is fastened to the cog member of the worm-gear, this cog being free to turn in a groove about the axle. To the worm is attached a slender rod of suitable length fitted with a milled head. As the milled head is turned, the worm engaging the cog rotates the movable disk. This device provides a quick means of both changing the value of open sector in continuous series and holding the movable disk firmly in any position in which it is turned. Obviously, with suitable and feasible modifications, gears of this type can be attached to operate each of the movable disks of the instrument described. With their addition extreme ease and simplicity are given to the operation of the instrument. Instead of having to loosen a nut, change the position of the disk by hand and again tighten the nut, all that is required is the turning of a milled head until the desired amount of exposure has been reached.

The driving mechanism seen in figure 1 consists of a motor of the synchronous type to give constant speed of turning the disks; a system of gears, worm and cog, for the reduction of speed of rotation of the disks; an intermittent gear of the cog type, the purpose of which will be described later; a gear-shift to change the speed of rotation, and an electric key for starting and stopping the motor.

The motor is wound to operate on a 60 cycle alternating current and to make 1,800 revolutions per minute. The first worm-gear reduces the speed in a ratio of 40: 1, or from 1800 to 45 revolutions per minute; a second reduces it in a ratio of 3: 1, or from 45 to 15 revolutions per minute, i. e., 1 revolution in four seconds. This gives the faster of the two speeds needed for making the test. A second speed of half this value is obtained with a cog-gear. By means of a gear-shift, the details of which need not be described here, either of the speeds just mentioned can be produced. With maximum breadth of open sector the lengths of exposure given by the two speeds are two and four seconds. Intervals of exposure shorter than two seconds and between two and four seconds are obtained by suitable adjustments of the breadths of the open sector. Since the speed of rotation is constant, one degree of open sector gives an exposure of eleven-thousandths second at the faster rate of turning and twenty-two thousandths second at the slower rate.

The intermittent gear connects the axle which turns the disks to the driving shaft. The relation of the parts of this gear is such that the disks make one complete rotation, then stop with the edge of disk *A* always in the same position in the circle of rotation, namely, just covering the test objects. The driving shaft, however, continues to turn until it is stopped by the operator, who starts the motor by pressing an electric key and stops it by releasing the key. By watching the

intermittent gear he can stop the driving shaft in such a position that when the next exposure is made a suitable interval will have elapsed between the starting of the motor and the beginning of rotation of the disks. A short interval is needed here both as preparation for the observer and to give the motor time to reach a constant speed.

Immediately behind disk *A* are two circular cards, 7 cm. in diameter, along the edge of which are printed the near test objects. The test object chosen was the letter E. These E's, eight in number, are so positioned that when the card is rotated they can be presented precisely at the same place, pointing up, down, to the right, to the left or in the four 45 degree positions, in any order chosen. At a corresponding position on the back of the cards are printed designations indicating the direction in which the exposed letter points. Each of the cards is mounted at its center on a small metal disk at the end of a grooved pin 6.5 cm. long. This pin passes through a collar provided with a set-screw, which feature permits of a certain latitude of adjustment of the distance of the test card from the exposure disks. To provide for the rotation of these cards, this collar turns in a sleeve supported by a grooved carrier which slides on a track to permit of the needed latitude of adjustment of the test object from right to left. In order that the test card when rotated shall come to rest in each of the positions just indicated, eight stops are provided, which are constructed as follows: Just back of the collar already noted and in contact with the sleeve is a shoulder of the same diameter as the sleeve. The front wall of this shoulder contains eight very shallow cups, the centers of which are spaced in a circle about the axis of rotation in the same radial planes as the centers of the test objects. In the adjacent wall of the sleeve, at the same distance from the axis of rotation as the cups, is a small socket of suitable depth. In this socket is a coiled spring, in the front end of which is embedded a small ball. This ball engages the cups as they pass in rotation. For convenience of rotation in the sleeve the collar is provided with a milled head, and to permit of smoothness and freedom of movement in turning, the circle containing the cups is grooved.

Between the observer and the exposure disks and as near to the latter as possible is a cardboard screen with an aperture of such a height and breadth as to give a clear view of the near and far test objects with each eye but to exclude the rest of the field of view. The near test cards are illuminated by well diffused light reflected from the mat surface of the back of the screen. The light is supplied by a tubular tungsten lamp enclosed in a cylindric housing provided with a vertical aperture of suitable breadth, which can be rotated about the lamp to give the desired angle of incidence of light on the screen and the desired amount of light reflected to the test surface.

The task set the observer by the near test objects may be varied to suit the purpose of the test by suitable changes in either the size or the distance of these test objects or in both. This feature requires special consideration in the use of the instrument in making a limiting test for age with reference to fitness for different types of work. This test will be discussed later in the paper.

The far test object, which is also the letter E, is printed on a small circular card, 3 cm. in diameter, mounted on a metal disk of the same diameter at the end of a short pin, which is inserted into a shaft and secured by means of a set-screw. The shaft is connected by gears to a small reversible motor, which turns the test object into the eight positions selected to provide an objective check on the judgment: up, down, to the right, to the left and in the four 45 degree positions. The motor is wound for constant speed, and the direction of rotation can be reversed at will by a switch. The stopping of the test object always in the same direction in the eight positions is accomplished by means of an intermittent gear of the Geneva type. The relation of the parts of this gear is such that the test object turns and stops in sequence as long as the motor is running. The interval of stopping is long enough for the operator to discriminate the test object and judge whether the position attained is the one desired, but not too long to interfere with expedition in making the test. The motor is started by pressing an electric key at the position of the operator and stopped by releasing the key. If the operator wishes to reverse the direction of rotation of the test object the key of the reversing switch is pressed. Thus the greatest possible latitude is afforded for the adjustment of the position of the test object in haphazard order.

The speed of rotation of the motor is 3,000 cycles per minute. This speed is reduced in the ratio of 80: 1, or 37.5 cycles per minute, by means of worm-gear connected to the shaft which turns the test object. The motor and gears are housed in an oblong box of suitable size mounted on a small table at a distance of 6 meters from the observer or at any other distance desired.

Surrounding the small metal disk to which the test surface is attached is a larger disk, 12 cm. in diameter, painted mat white. This furnishes the more remote surrounding field for the test object and is surfaced to give the same reflection as the small circular card on which the test object is printed. A hole is cut in this field just large enough to receive the test card. The test object thus turns, but the field is stationary, the fitting of the test card and field being so close that an unbroken surface is seen by the observer in position at the exposure apparatus. The test surface is illuminated from in front to any brightness desired. The far test object and the near test objects should have the same inten-

sity of illumination. The adjustment of these intensities can be made most conveniently by measuring the brightness of the far test card and matching that of the near test cards to it by viewing the near and far test surfaces in quick succession from the position of the observer at the exposure apparatus. A unit which we have recently devised for varying intensity over a wide range is excellent for the illumination of the far object.[3] It can be mounted on a floor stand, or a smaller unit of the same type can be mounted on a bracket support fastened to the table. In these units the intensity of light can be changed in continuous series from zero to full value by a simple mechanical device, without change in the color or composition of light.

A convenient type of head-rest for use with the instrument is shown in the illustration previously referred to.[2] This head-rest is securely fastened to the table on which the exposure apparatus is supported. Three adjustments are provided, which are operated by coarse-threaded screws having a suitably fast motion in the following directions: up and down, to the right and to the left and backward and forward. By means of these adjustments the observer's eyes can quickly be brought into the required position. The height of the supporting table is also adjustable.

The instrument is easy and convenient to use. As has already been indicated, its manual operation requires nothing more than the pressing and releasing of an electric key and, in the preferred form, the adjustment of the disks by turning a milled head. We feel that it can be confidently recommended as entirely feasible for practical work. As shown, the instrument is only a laboratory model. Designed for practical use, the exposure apparatus can be made much smaller and neater, and both it and the far test object can be mounted on floor stands.

PROCEDURE OF THE TEST

The three test objects and the eyes of the observer are adjusted to the same vertical level, the near test cards being separated enough to give the observer a clear view of the far test object with each eye. Disk *B* is adjusted to give a length of exposure that will just permit of discrimination of the near test object on the left. Disk *C* is adjusted to give a length of exposure that will just permit of discrimination of the far test object and the change of adjustment of the eyes needed for this discrimination. Disk *D* is adjusted so as just to permit of discrimination of the near test object on the right and the change of adjustment required for this discrimination. If it should be desired to measure the time required for the passage from near to far and

3. Ferree, C. E., and Rand, G.: Lamp for Determination and Measurement of the Preferred Intensity of Light for Reading, Arch. Ophth. **12**:45 (July) 1934.

back again to near in continuous change, disk *C* is turned back out of the way, and the adjustment for the double excursion is made with disk *D*. While the measurement can be made more quickly by this procedure than by the first, it has the following disadvantages: (*a*) A separate determination is not obtained of the time required for the two halves of the excursion, from near to far and from far to near. This separation may be of importance in testing in clinics and in other types of testing. (*b*) No provision is made for preventing the eyes from lingering on the far object before beginning the excursion toward the near object. The interval required for the double excursion as measured directly by this procedure, for example, is appreciably longer than when it is determined by adding the values of the two halves as measured by the first procedure. This tendency of the eyes to linger when they can thus not only makes a difference in the absolute value of the results, but it may also affect comparative values. That is, not only does the latitude offered give a chance for a variable performance or a variable error from time to time with the same observer, but it leaves the results open to the influence of this factor in the case of different observers. It may be, on the other hand, that individual differences in the laziness of the eyes are an important factor in the rating of persons as to vocational fitness and that the second procedure is therefore better fitted for this purpose than the first.

It should perhaps be noted that the adjustment of disk *B* is not made primarily for determining speed of perception with the eyes in approximate adjustment for the near object, although this is an item that might be of value in a comparative study of the lag of ocular functions in different persons. It is made chiefly in order that the determination of the time to pass from near to far may be made with greater precision. That is, if the observer is to begin his excursion from near to far with an exact adjustment for clear seeing at near, he must be required as a check to start with a task which involves a report of clear seeing at near. The mere instruction to fixate a cross or other object will not guarantee the needed adjustment. Moreover, the adjustment must be precisely controlled if the results are to be safeguarded against the variable error already discussed. If it is not controlled, the eyes may linger too long at near or begin their change toward far too soon and the amount of the deviation in either direction may vary from time to time and from person to person.

In making the test, either the oculomotor or the accommodative reaction may be emphasized. To emphasize the part which oculomotor efficiency plays in the test, the range of lateral excursion of the eyes should be increased. This can be accomplished by moving the near test objects as far as possible to the right and left of the median plane.

If need be, the breadth of the exposure disks may be increased. Also, the far test object may be given other locations than the median plane, and, if desired, its distance from the near objects can be decreased. The size of the image on the retina for objects subtending a visual angle of 1 minute is of the order of thousandths of a millimeter. Great precision of coordination of action of the ocular muscles is required to superimpose these images so perfectly as to cause no blurring due to doubling. That this can be done so quickly by the action of twelve muscles, each of which plays a part in every movement and all of which collectively serve to hold the eyes in position, is almost unbelievable. It could not be done at a medium or high rate of speed if the mechanism were structurally or functionally at fault. The realization of this is sufficient to indicate how effective a dynamic test of speed of vision should be as a check on the structural and functional perfection of the motor mechanism. This form of the test offers perhaps the greatest possibilities for usefulness in the work of the clinic.

If the object of the test is to measure speed of vision with a change of accommodation and as little emphasis as possible on the lateral excursion of the eyes, the test should be performed with one eye alone, and the near test objects should be brought as close as possible to the median plane, with just enough space left between them to enable the subject to view the far object. This relation of the test objects reduces the amount of ocular movement to a minimum, an amount that is perhaps negligible in the total performance. Again, measurement may be made of the time required to change from near to far and from far to near in separation or in combination. There is perhaps in this case a special interest in the separate determination of the two components of the adjustive process for distance, or what is often called accommodation and relaxation of accommodation.

Obviously, the test in any of its forms can be made in three ways: (*a*) As has just been described, the maximum performance for each person may be determined. This would be the analog of making tests of visual acuity, for example, in terms of the minimum visual angle that can be discriminated. This procedure is the longest because it requires a correct adjustment of the disks for each observer, but it results in a much finer grading of performance. (*b*) Any suitable number of levels of performance may be chosen and the apparatus set at once to give these levels. This method of testing would place persons in ranks or groups and is the analog of the Snellen method of grading visual acuity. It is a quicker procedure than (*a*), but the grading is correspondingly rough. By a practiced examiner, testing by this method should take but a few minutes. In forming such a graded scale in our preliminary work we have used steps of two-tenths second for

the double excursion. These intervals have been found very suitable by Dr. Robertson in his work of classifying aviators as to fitness of performance.[4] An alternate procedure would be to determine directly specific vocational scales made up of the number and breadth of steps needed for the various vocations. (*c*) Critical or limiting values could be established for any purpose for which such values are desired. The instrument could then be set for these values after the usual preliminary trials to familiarize the observer with the test, and the determination made whether he could give the judgments required, which could be done in one rotation of the exposure apparatus.

In the application of the test to work in clinics, critical values could be established as separating pathologic from nonpathologic conditions in persons of different ages. The test could then be made, as has already been indicated, with a single setting of the apparatus. Or the speeds could be measured for each person and the results compared either with a predetermined scale of norms or, as a check on progress, with a result obtained for that person at some other time.

USES OF THE INSTRUMENT AND TEST

The instrument makes possible: (*a*) The use of a set of very sensitive tests which take into account as no other tests do both the motor and the sensory functions of the eyes in just the proportion that they occur in the act of seeing objects in different directions and at different distances.[5] Composite tests of this kind give by direct measurement information that cannot be obtained, and permit of conclusions that cannot be drawn, from any amount or kind of separate testing of functions.

(*b*) The testing of the dynamic speed of vision with either the oculomotor or the accommodative feature emphasized. The test made with the accommodative feature emphasized gives the speed of accommodation as nearly as possible, it would seem, for that result to be obtained. Similarly, the arrangement of the conditions of the test so as to emphasize the importance of convergence and divergence in the results measures the speed for these functions as nearly in complete separation as can be accomplished.

(*c*) The measurement of the time required to change from near to far and from far to near either in combination or separately.[5] The measurement of the time required for these shifts separately in the form of the test in which the oculomotor functions are emphasized

4. Robertson, C. J.: A Comparative Study of the Measurement of the Speed of Adjustment of the Eye for Near and Far Vision, U. S. Nav. M. Bull. **33**: 187, 1935.

5. Robertson, C. J.: Measurement of Speed of Adjustment of Eye to Near and Far Vision: A Further Study, Arch. Ophth. **15**:423 (March) 1936.

gives a sensitive comparison of the facility and condition of the converging and diverging mechanisms, which may be more significant and comprehensive than tests of the duction type. Such measurements also provide a way of making a quantitative determination of what the results of the duction tests mean in terms of typical oculomotor performances. In the form of the test in which the accommodative feature is emphasized, the measurement of the time required for the shifts separately gives a comparison of the time required for the action of the muscles of accommodation and the lens material in the change from near to far and from far to near, which may have both a practical and a theoretical bearing. All the aforementioned possibilities of measurement have, we believe, great value in relation to the examination of the eyes in the work of the clinic.

In addition to these clinical applications, the following further uses of the instrument and the measurements that it makes possible may be discussed:

1. A test of vocational fitness in all cases in which dynamic speed of vision is an important requirement. Most of the work requiring speed of vision is done with moving eyes. For such work a static test, which tests only the speed of reaction of the sensorium, is incomplete. A quickly reacting sensorium, it is true, gives a quick discrimination of the object and a quicker and more effective guidance of the movement of the eyes. However, it is not nearly so important for the quick use of the eyes in the greater part of work that persons are called on to do as are quick oculomotor and accommodative adjustments. The dynamic test of speed of vision was devised by us during the World War as a test for fitness for aviation. We thought that the eyes of aviators should have a supernormal speed and precision of coordinated response in the three fundamental reactions: oculomotor, accommodative and sensory. Only the reaction of the sensorium is tested by static tests of speed of vision, and the important element of speed is entirely left out in all other types of ocular tests. The incompleteness and lack of special fitness of the usual clinical and ophthalmologic tests for this purpose should be obvious without further elaboration.[6]

2. A limiting test for age. As the eyes grow older the importance of accommodation in a dynamic test for speed of vision increases until it becomes the dominant factor in the result. Speed of accommodation is not an important factor in the results for the young eye unless there is some accommodative abnormality. Accommodation is the first of the ocular functions to deteriorate with age and the one that shows the closest correlation with age. The earliest manifestation of what would ordinarily be called a deterioration in this function, that is, a

6. Footnotes 2, 4 and 5.

deterioration of significant practical importance, is, so far as measurements have been made, a decrease in speed. A comparative test of dynamic speed of vision of the eyes of the young and those of the middle-aged and near middle-aged furnishes striking and most convincing evidence that the latter are under a special handicap in regard to all types of work that require speeds that are normal or supernormal for young eyes.[5] There are many vocations for which a high standard of requirement in this connection is needed. In a machine age, in which all industrial performances are quick and public and private conveyances travel at rates of speed that were formerly almost inconceivable, the demands put on the speed of the eyes' reactions have become increasingly rigorous. For example, many automobile drivers in an early stage of presbyopia have advised us that they dare not take their eyes off the road for the length of time that they require even to read the speedometer. Driving under conditions which do not permit of the inspection of the instrument panel is, it will be granted, somewhat hazardous. Further, the requirements of factory workers who operate machines are by no means low. It is our strong belief that ocular tests in which the factor of speed is not given great importance are not a safeguard against either inefficiency of performance or dangerous accidents.

There is also, of course, an important need for a limiting test for age in aviation. The aviator in combat flying and in landing, particularly on water, needs everything that can be had in the way of dynamic speed of vision. In the early days of aviation—for example, during the World War—such a test was not so greatly needed as now. The vocation was new, and by far the greater number of aspirants were young men. Now the aviators of that time, such as have survived, have grown older. It is difficult to make them realize that they may no longer be fit for the service or all branches of it and hard, without definite and concrete evidence of unfitness, to make a case against them that will stand.

The chief value of the test as a limiting test for age is in its application to persons between the years of 30 and 45 or 50, the period for which a precise and sensitive test is most needed and most difficult to obtain.

3. A means of measuring ocular fatigue and recovery and of testing individual susceptibility to fatigue and the capacity to recover. The addition of speed or power to sustain to any test performance gives great sensitivity for the detection of fatigue. For example, in a study of ocular and oculomotor fatigue, the test of dynamic speed of vision can be made at suitable intervals during the performance of a task, and from the results a curve for fatigue can be plotted for each person tested.

From these curves individual susceptibility to fatigue of persons in the same age group and in those of different age groups can be compared. There are great individual differences in this susceptibility, and it is needless to point out that it is an important factor to be considered in determining ocular fitness for any type of work, especially in all performances requiring a high degree of ocular fitness. Age, moreover, is a most important factor in this susceptibility. One would expect, therefore, that using the test of dynamic speed of vision as a fatigue test would be a most sensitive way of determining the effects of age on ocular fitness.

In addition to determining ocular fitness and susceptibility to ocular fatigue, the instrument and test may be used for testing the rate of recovery from ocular fatigue. From a study of the curves for ocular fatigue and recovery, persons of the same age group and those of different age groups can be compared as to susceptibility to ocular fatigue and the capacity to recover. A greater difference in age might be expected for the latter than for the former. Our experience and observation is that while older persons become fatigued more quickly, the especially marked handicap of age is on the side of recovery.

An instrument that furnishes a means of measuring and making a quantitative comparison of both ocular fatigue and recovery, in addition to measuring speed of performance, should have both important scientific interest and a practical utility over a wide range. Such a means would be of value not only in the selection of persons in all vocations in which special ocular fitness is required but in checking up on the persons selected for their ocular fitness at any time to accomplish an assigned task. A record of the dynamic speed of vision and the rate of fatigue and recovery for any person gives a comprehensive estimate of his ocular fitness. In addition to the particular service rendered, studies comprising such determinations give information of general value.

In connection with the discussion of ocular fatigue and recovery it should be borne in mind that oculomotor fatigue and depression sustain a relationship to general bodily fatigue. This relationship is sufficiently close to suggest that a fairly comprehensive estimate may be had of the bodily condition by testing the combined ocular and oculomotor performance. Just how much work has been done in direct confirmation of this sympathetic relationship we are not prepared at this time to state. However, our attention has been called to experiments recently made in Soviet Russia, where a great deal of interest is being taken in physiologic optics of the practical type that we have been trying to develop. These experiments were conducted by J. J. Troumpaitz in the Laboratory for Lighting Research at the Leningrad Institute for

Industrial Hygiene and Accident Prevention.[7] The test of the ocular condition used was one devised by us for studying the effect of lighting conditions on ocular fatigue by measuring the eyes' power to sustain clear seeing for a period of time. Bodily fatigue was induced by the operation of a device called a bicycle-ergograph, which was selected for the study because its operation required no fatiguing use of the eyes. Nevertheless, a close relationship was shown to exist between bodily fatigue as measured by the ergograph and ocular fatigue as measured by the test of power to sustain clear seeing.

4. A means of training eyes to greater oculomotor and accommodative facility. The discussion should not be brought to a close without noting the possibility of using the instrument as a means of attaining oculomotor and accommodative facility. Its daily use for a suitable length of time might well serve to raise eyes slightly or moderately subnormal to normal proficiency and normal eyes to a needed supernormal proficiency. Under the spur of a speed requirement it would seem that the coordination of so many individual performances might be facilitated to a significant amount by daily practice.

SUMMARY

The instrument described for measuring dynamic speed of vision, speed of accommodation and ocular fatigue is a compound rotary tachistoscope comprising a driving mechanism, four sectored disks so arranged and of such sizes as to expose in immediate succession, in turning, a near test object on the left, a far test object in the median plane and a near test object on the right. The test objects are the letter E, the openings of which can be turned in eight different directions to give an objective check on the judgment. The far test object is provided with a remote control such that these adjustments can be made by pressing an electric key at the position of the examiner. The distance of the far test surface and the lateral separation of the two near test surfaces can be varied at will. The sectored disks are turned by means of a motor of constant speed provided with gears to give suitable reductions in speed and an intermittent gear which causes the disk covering the test objects prior to the beginning of the exposure to stop in exactly the same position at the end of a single rotation. In the preferred form the values of open sector are adjusted by small worm-gears, which serve both to change the position of the movable disks and to hold them firmly in position for any given setting. Exposure may be made in con-

7. From a report of work submitted personally to the authors by J. J. Troumpaitz. The purpose of the experiment was to show the loss of efficiency which the eyes sustained during a period of heavy physical work.

tinuous series up to four seconds. Both the angular values of open sector and the times of exposure can be read from suitably positioned graduated scales.

The instrument makes possible: (*a*) the use of a set of very sensitive tests which take into account as no other tests do both the motor and the sensory functions of the eyes in just the proportion that they occur in the act of seeing objects in different directions and at different distances, (*b*) the testing of the dynamic speed of vision with either the oculomotor or the accommodative feature emphasized and (*c*) the measurement of the time required to change from near to far and from far to near in combination or separately.

The following practical uses of the instrument and test are discussed: (*a*) as a means of detecting abnormalities and depressions in the oculomotor functions in the work of the clinic; (*b*) a test for vocational fitness in all cases in which dynamic speed of vision is an important requirement; (*c*) as a limiting test for age; (*d*) as a means of measuring ocular and oculomotor fatigue and recovery and of testing individual susceptibility to ocular fatigue and the capacity to recover, and (*e*) as a means of training eyes to greater oculomotor and accommodative facility.

PANOPHTHALMITIS DUE TO CLOSTRIDIUM WELCHII

H. C. KLUEVER, M.D.
AND
C. S. O'BRIEN, M.D.
IOWA CITY

Gas-producing anaerobic bacilli occur but rarely in cases of inflammation of the eye; however, such organisms have been reported in a few cases of panophthalmitis. Chaillous [1] in 1904 isolated Bacillus perfringens from the vitreous of an eye in which there was a foreign body. Since that time two other cases [2] have been reported by the same author, and similar cases have been reported by Darier,[3] James,[4] Oreste,[5] Heath,[6] Ridley,[7] Hamilton,[8] Beery [9] and Walker.[10]

Veillon and Morax [11] isolated two types of anaerobic bacilli in a case of gangrenous dacryocystitis, but gas was not formed by either organism. Lutz,[12] on routine examination, found gram-positive bacilli in

From the Department of Ophthalmology, State University of Iowa College of Medicine.

1. Chaillous, J.: Infection traumatique du globe oculaire par un microbe anaérobie (Bacillus perfringens), Rec. d'opht. **26**:678, 1904.

2. Chaillous, J.: Deux cas d'infection traumatique de globe oculaire par un microbe anaérobie (Bacillus perfringens), Ann. d'ocul. **134**:115, 1905.

3. Darier, A.: Panophtalmie et bacillus perfringens, Clin. opht. **11**:266, 1905; Panophtalmie gazeuse et bacillus perfringens, ibid. **12**:227, 1906.

4. James, R. R.: A Contribution to the Bacteriology of Panophthalmitis, Tr. Ophth. Soc. U. Kingdom **30**:179, 1910; Penetrating Injury of the Globe with Panophthalmitis Due to a Gas-Forming Micro-Organism, Ophth. Rev. **29**:161, 1910.

5. Oreste: Plaie pénétrante de globe par coup de fouet (infection par le bacillus perfringens), Ann. d'ocul. **143**:35, 1910.

6. Heath, W. E.: B. Welchii Infection of Globe Following Perforating Injury, Brit. J. Ophth. **13**:574, 1929.

7. Ridley, F.: Gas Gangrene Panophthalmitis, Tr. Ophth. Soc. U. Kingdom **49**:221, 1929.

8. Hamilton, J. B.: Notes on B. Welchii Infection of the Globe, Brit. J. Ophth. **14**:452, 1930.

9. Beery, E. M.: Intraocular Foreign Body with Bacillus Welchii Infection, Am. J. Ophth. **15**:1022, 1932.

10. Walker, S., Jr.: Bacillus Welchii Panophthalmitis, J. A. M. A. **102**:1561 (May 12) 1934.

11. Veillon, A., and Morax, V.: Péricystite gangréneuse, Ann. d'ocul. **123**:175, 1900.

12. Lutz, A.: Ueber einige Fälle von ektogener Panophthalmie (Infectionen mit Pneumokokkus Subtilis und Anaërobionten), Klin. Monatsbl. f. Augenh. **48**:31, 1910.

three cases of panophthalmitis following entry of an intra-ocular foreign body; the organism produced gas and readily formed spores. Hanke and Tertsch [13] reported several cases of panophthalmitis, in one of which the infection was due to an unidentified gram-positive, gas-producing bacillus.

In all the reported cases the patient recovered rapidly after evisceration or enucleation of the affected eye. Antiserums were administered by Heath,[6] Ridley,[7] Hamilton [8] and Walker.[10] Hamilton [8] stated: "Perhaps the favorable prognosis is due to the treatment. It was found in the late war, before serum was administered as routine, that wide excision of infected tissue gave the best results. What more perfect excision of infected tissue can be imagined than a simple evisceration?" Walker [10] suggested that the small amount of muscle tissue in the orbit might be concerned in the favorable prognosis. Frasier [14] observed that as long as muscle was not infected the condition remained an anaerobic infection but that after muscle became involved the condition changed to gas gangrene. The small amount of devitalization and tissue destruction resulting from most intra-ocular foreign bodies may also be a factor in the control of extension of anaerobic infection from the orbit.

REPORT OF A CASE

H. C., a farmer, aged 37, was admitted to the University Hospitals on Nov. 15, 1934. The familial, the personal and the social history were irrelevant. Twenty-four hours prior to admission the patient had been struck in the right eye by a fragment of steel while working with a punch and hammer on a farm tractor. He did not seek the advice of a physician until twelve hours after the injury, when the eye became painful and vision blurred. Opiates were administered for pain; atropine was instilled into the conjunctival sac of the injured eye, and the patient was advised to enter the hospital. On admission vision in the right eye was reduced to light perception, and the patient complained bitterly of pain, which had increased in severity during the preceding twelve hours.

Photophobia was pronounced, and the right eyeball was tender. The lids were slightly edematous, but ocular rotations were full in all directions and not painful. The bulbar conjunctiva was acutely injected but only slightly chemotic. A faint gray line 3 mm. long, representing the point of entrance of the foreign body, was present in the upper nasal quadrant of the cornea. Many fine cyclitic deposits were present on the lower third of the corneal endothelium, and a small hypopyon was developing in the deep anterior chamber. The pupil, which measured 2.5 mm. in diameter, was fixed and could not be dilated with either atropine or epinephrine bitartrate. The lens was cataractous, and the fundus was invisible. The intra-

13. Hanke, V., and Tertsch, R.: Einige seltene Infectionen des Auges, Klin. Monatsbl. f. Augenh. **45**:545, 1907.

14. Frasier, J.: The Clinical Features and Treatment of Anaerobic Infection of Wounds and Gas Gangrene, Medical Research Council, Special Report Series, no. 39, London, His Majesty's Stationery Office, 1919.

ocular tension was normal. Sweet's localization with roentgenograms revealed the presence of a foreign body of metallic density in the posterior segment of the eye. The left eye was normal.

General physical examination, including laboratory studies, gave essentially normal results. The patient was given tetanus antitoxin (1,500 units) intramuscularly and typhoid vaccine (25,000,000 killed bacilli) intravenously. Instillations of scopolamine hydrobromide (a 0.2 per cent solution) were made, and hot compresses were applied to the injured eye. Removal of the foreign body was not attempted.

Twelve hours later, thirty-six hours after the injury, the eye was extremely painful. The lids were swollen; the globe was immobile and slightly proptosed; the conjunctiva was extremely chemotic, and there was a collection of purulent material in the palpebral fissure. The cornea was comparatively clear, and the wound remained closed. The anterior chamber was filled with pigment, fibrin and pus. The intra-ocular tension was greatly increased. The patient's temperature was 103 F.

Evisceration was advised, but during a two hour period which elapsed before the operation could be performed a rapid increase of the proptosis and edema occurred. Several bubbles of gas appeared in the anterior chamber, and a preoperative diagnosis of infection with gas bacilli was made.

Numerous bubbles of gas, pigment and necrotic uveal material flowed out of the anterior chamber at the time of evisceration. Twenty cubic centimeters of polyvalent gas gangrene antitoxin (Clostridium Welchii,[15] Clostridium oedematis-maligni,[15] Clostridium oedematiens[15] and Bacillus sordellii[16] was given intravenously after the evisceration, and this treatment was repeated twelve and twenty-four hours later.

The swelling of the lids subsided rapidly, and convalescence was normal. The patient was permitted to sit up on the fourth, and was discharged on the thirteenth, postoperative day.

LABORATORY STUDIES

Bacteriologic Examination.—Studies of necrotic material taken from the anterior chamber at the time of evisceration showed many short, thick, gram-positive, nonmotile rods measuring from 1 to 1.5 by from 4 to 8 microns and occurring singly and occasionally in pairs, as shown in the illustration. No other organisms were seen. Numerous greenish-gray globular granules of uveal pigment were distributed throughout the smears.

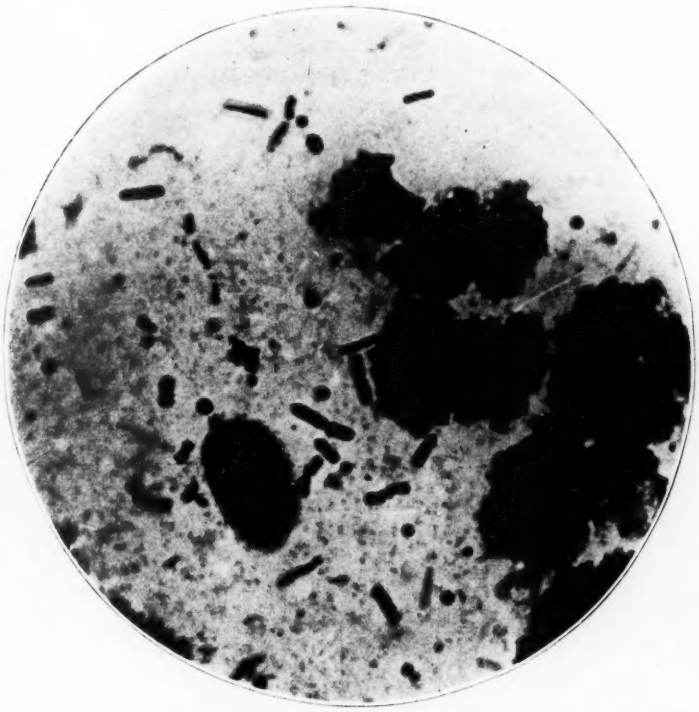
Cultures on blood agar failed to grow under aerobic conditions, but under anaerobiosis produced by alkaline pyrogallol hemolytic surface colonies attained a size of from 1 to 2 mm. in diameter in from twenty-four to forty-eight hours. The areas of hemolysis were perfectly clear and measured from 2 to 4 mm. in diameter. The colonies were round, flat and transparent, except at the centers, where they were slightly raised and opaque. The margins were finely granular and somewhat crenated. The colonies were viscid and adhered to the mediums and had a characteristic rancid, sour odor.

---

15. Terminology used by Bergey (Bergey's Manual of Determinative Bacteriology, Baltimore, Williams & Wilkins Company, 1934).

16. Hall, I. C., and Scott, J. P.: Bacillus Sordellii, a Cause of Malignant Edema in Man, J. Infect. Dis. **41**:329 (Nov.) 1927.

An acid reaction, with the formation of clots and the evolution of gas, i. e., so-called stormy fermentation, was produced in milk mediums in twenty-four hours. Cultures on coagulated blood serum slants produced no liquefaction. Brain medium without iron wire was not blackened during fifteen days of incubation under anaerobiosis. Gelatin was liquefied. Saccharose, dextrose, levulose, galactose, maltose, lactose, starch, glycogen and inositol were readily fermented, with the formation of acid and gas. Glycerol and raffinose were fermented with difficulty, and the formation of acid and gas appeared only after ten days of incubation. Inulin, xylose, mannitol, dulcitol and salicin were not fermented, even after fifteen days of incubation. The acidity was determined at the end of the periods



Photomicrograph of smear of necrotic material from the anterior chamber, showing coccus-like granules of uveal pigment and Cl. Welchii. Magnification, × 2,000.

of incubation by the addition of bromthymol blue, a 0.04 per cent solution being used.

An active growth, with the evolution of gas, was observed in meat infusion broth; the medium became turbid, but cleared when the organisms finally sank to the bottom of the tube. The reaction was strongly acid.

Capsules were difficult to demonstrate. Smears for such studies were obtained from body fluids of a guinea-pig which had died following inoculation. These preparations were not heated and were stained according to the methods of Welch [17] and Hiss.[17] They showed deeply stained bacilli surrounded by thin, transparent, refractile unstained coats.

17. Zinsser, H.: A Textbook of Bacteriology, New York, D. Appleton & Company, 1928, p. 95.

Spores were demonstrated only in cultures grown in the clear fluid at the bottom of coagulated blood serum slants. They were never observed in cultures in any other mediums, including meat infusion broth from which sugar had previously been eliminated by the growth of Escherichia communior. The spores were placed centrally; they were oval, with slightly rounded ends, and stained easily by Moeller's [17] method.

Experiments on Animals.—A small amount of necrotic material from the anterior chamber of the infected eye was mixed with sterile water and injected intravenously into a rabbit. The animal was killed with chloroform ten minutes later, and the body was incubated at 37 C. for twelve hours. Its gross size appeared to have doubled during the twelve hours of incubation, and large blebs of gas were everywhere present under the skin and in the tissues. The muscles were soft, friable and pale pink, and the body had a sour odor. A pure culture of the anaerobe was recovered from the blood of the rabbit's heart.

Two mice, two guinea-pigs and one rabbit were each given an intramuscular injection of 0.25 cc. of a forty-eight hour culture in a solution of beef serum containing 1 per cent starch and diluted with two parts of distilled water. One guinea-pig died after thirty hours and one mouse after forty-eight hours, but the other animals recovered. A third guinea-pig was given 0.5 cc. of the preparation and died twenty hours later.

COMMENT

By a process of elimination the pathogenic organism in this case of panophthalmitis was determined to be Cl. Welchii.

The foreign body which entered the eye and gave rise to the infection might have been contaminated with any of the many anaerobic organisms commonly found in soil. The majority of such anaerobes are nonpathogenic and do not produce hemolysis when grown on blood agar; [18] consequently, since nonhemolytic colonies were not encountered at any time in our case, it was assumed that nonpathogens were absent.

Clostridium histolyticum (Bacillus histolyticus of Weinberg and Séguin [19]) holds a position intermediate between acutely pathogenic anaerobes and the secondary nonpathogenic saprophytes. This organism liquefies coagulated blood serum, and since in our cultures coagulated blood serum was not liquefied, Cl. histolyticum was also eliminated.

The principal pathogenic species are Cl. Welchii (Bacillus aerogenes-capsulatus of Welch and Nuttall,[20] Bacillus phlegmonis-emphysematosae

18. Hall, I. C.: The Study of Obligately Anaerobic Bacteria, leaflet 3 by Committeeman on Anaerobic Methods, Society of American Bacteriologists, ed. 2, 1932.

19. Weinberg and Séguin: Démonstration de lésions provoquées chez le cobaye par le B. histolyticus; quelques observations sur la toxine de ce microbe, Compt. rend. Soc. de biol. **80**:157, 1917.

20. Welch, W. H., and Nuttall, G. H. F.: A Gas-Producing Bacillus (Bacillus Aerogenes Capsulatus, Nov. Spec.) Capable of Rapid Development in the Blood-Vessels After Death, Bull. Johns Hopkins Hosp. **3**:81, 1892.

of Fraenkel [21] and Bacillus perfringens of Veillon and Zuber,[22] or Bacillus enteritidis-sporogenes of Klein [23]), Cl. oedematis-maligni (vibrion septique of Pasteur and Joubert,[24] or Bacillus oedematis-maligni of Flügge [25]) and Cl. oedematiens (Bacillus oedematiens of Weinberg and Séguin [26]). Cl. Welchii is the most common species and Cl. oedematiens the least common.

Both Cl. oedematis-maligni and Cl. oedematiens are motile and readily form spores. In our case motile forms were never seen, and spores were demonstrated with great difficulty; consequently it was assumed that these organisms were absent.

The important characteristics of the organism which was isolated from the injured eye corresponded with those of Cl. Welchii. It was a nonmotile, obligative anaerobic, gram-positive bacillus which produced demonstrable, centrally placed spores only in blood serum. With this organism blood agar was hemolized and gelatin liquefied; there was stormy fermentation of milk; brain medium was not blackened, and most simple sugars, except inulin, xylose, mannitol, dulcitol and salicin, were fermented. The organism was pathogenic for mice and guinea-pigs, and in the living animal it produced extensive formation of gas at the site of inoculation; after death gas was formed throughout the body after the latter was incubated at 37 C. for several hours. Since inulin was not fermented, the organism was classified as Cl. Welchii type II.[27]

SUMMARY

Fulminating panophthalmitis with gas in the anterior chamber developed within a few hours after a penetrating injury of the eye. A clinical diagnosis of infection with gas bacilli was made. The eye was eviscerated, and polyvalent gas gangrene antitoxin was administered. The patient recovered. Cl. Welchii was isolated in pure culture from the anterior chamber.

---

21. Fraenkel, E.: Ueber die Aetiologie der Gasphlegmonen (Phlegmone emphysematosa), Centralbl. f. Bakt. **13**:13, 1893.

22. Veillon and Zuber: Recherches sur quelques microbes strictement anaérobies et leur rôle en pathologie, Arch. de méd. expér. et d'anat. path. **10**:517, 1898.

23. Klein, E.: Ueber einen pathogenen anaeroben Darmbacillus, Bacillus enteritidis sporogenes, Centralbl. f. Bakt. **18**:737, 1895.

24. Pasteur and Joubert: Charbon et septicémie, Bull. Acad. de méd., Paris **6**:781, 1877.

25. Flügge, C.: Die Microorganismen, mit besonderer Berücksichtigung der Aetiologie der Infectionskrankheiten, in Fermente und Mikroparasiten, ed. 2, Leipzig, F. C. W. Vogel, 1886.

26. Weinberg and Séguin: Le B. oedematiens et la gangrène gazeuse, Compt. rend. Soc. de biol. **78**:507, 1915.

27. Bergey, D. H.: Bergey's Manual of Determinative Bacteriology, Baltimore, Williams & Wilkins Company, 1934, p. 467.

Clinical Notes

SPECIAL DEVICE FOR LOCALIZATION AND TREATMENT OF RETINAL TEAR WITH GALVANIC CURRENT

CLIFFORD B. WALKER, M.D., LOS ANGELES

When one has observed the splendid results which are obtained in the treatment of separated retina by catholysis (Vogt), one naturally begins to search for the finest and sharpest possible needle for use in such treatment, for it is conceivable that a needle sufficiently fine and sharp could repeatedly penetrate the sclera and the vessels of the choroid and retina while carrying a negative galvanic current of 1 milliampere without producing enough leakage of the subretinal fluid or blood to give a handicap or detriment of any sort during a two hour operative period.

The bending and breaking characteristics and the penetrating length of a needle of this kind must be fully controlled to make it satisfactory for the separated retina operation, and one should be able to perform from 125 to 175 scleral punctures before it becomes dull.

CONSTRUCTION OF THE INSTRUMENT

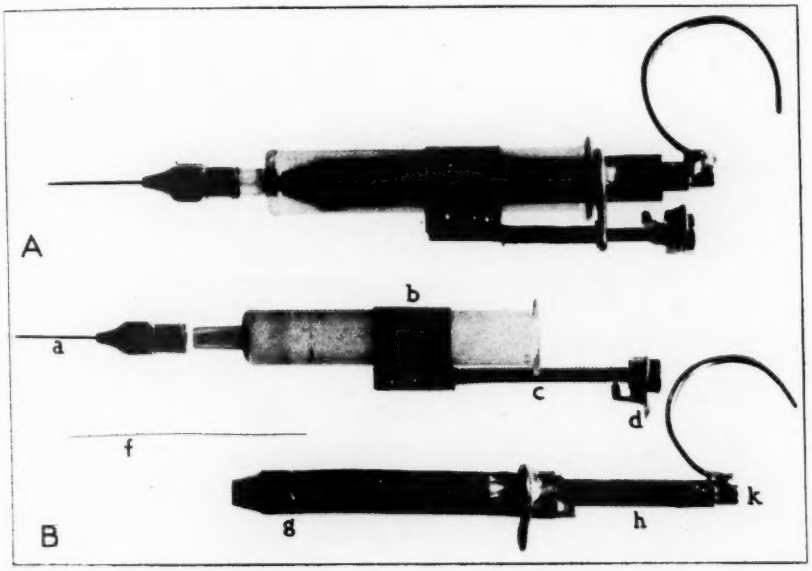
The instrument pictured and described in this paper represents a satisfactory device to meet the aforementioned requirements. It operates a 25 per cent iridium-platinum microneedle with a diameter as fine as 3/1,000 inch (0.076 mm.) and almost no taper. The length of penetration can be adjusted from 1 to 10 mm. It has not been found to be either necessary or practicable to use a needle with a diameter of less than 3/1,000 inch to gain the desired results. Even a diameter of 4/1,000 inch (0.102 mm.) is satisfactory. All needles must be highly polished and very sharp.

A needle of this fineness must at all times be protected by a cannula or jacket of correspondingly narrow tubing. This may be accomplished by using the barrel of a standard 2 cc. hypodermic syringe, fitted with either a plain slip point needle or, better still, a lock joint, stainless steel or platinum needle 25 gage.

In the lower part of the figure *f* illustrates the formation of the microneedle at the end of a 25 per cent iridium and platinum wire 2 inches (5.08 cm.) in length and 7/1,000 inch (0.179 mm.) in diameter. The blunt end of this wire, after passing through the hypodermic needle and into the barrel, is held in a pin chuck (*Bg*), which takes the place of the piston of the hypodermic syringe but does not fit so tightly. The hypodermic needle acts as the protective sleeve or cannula. The usual sharp single point of the hypodermic needle was not satisfactory. Therefore, a special tip (*Ba*) was formed with two very sharp tips or spurs, 0.5 mm. long. These two sharp spurs, when pressed on the

sclera lightly, prevent any slipping or rotation while the trocar needle is puncturing the sclera and is drawn back into the cannula. However, if the tip should accidentally slip and bend the microneedle it can be straightened immediately with the rubber-gloved fingers and, unless acutely kinked, continues to work well, if sharpness has not been lost.

The sharpness and polish of the microneedle are even more important than the sharpness of the spurs and are best tested by observation with the high power slit lamp. All other tests, except those made on the sclera itself, have proved unreliable. With the correct sharpness one can hardly feel the resistance of penetration. In order fully to protect the microneedle at various stages, it is loaded last of all into the completely assembled instrument so that the blunt end of the needle



Photographs of the automatic microneedle device. *A* shows the apparatus completely assembled. The piston chuck is held down so that the needle appears in the extended position. *B* shows various parts of the device unassembled, as though for cleaning; *a* indicates the cannula with a double short prong tip to prevent bending; *b*, the tight-fitting but movable band around the barrel for adjustment of the penetrating depth of the needle; *c*, the guide bar with spring, which controls the automatic withdrawal action for the protection of the needle; *d*, the small locking lever to prevent accidental protrusion of the needle during sterilization or transit; *f*, the microneedle formed on the end of a 25 per cent iridium and platinum wire 2 inches (5.08 mm.) in length; *g*, the nonrotating sheath and tip of the chuck, which displaces the ordinary piston of the syringe; *h*, the rotating central portion of the chuck which is rotated to hold the shaft of the needle and carries a thumb ring for control of the motion, and *k*, the end receptacle for the "plug-in" tip of the cord from the negative galvanic pole.

shaft is passed first into the hypodermic tip and then, under observation, through the glass barrel into the pin chuck. When it lies in the chuck, with just the desired length protruding from the cannula, the chuck is

closed by rotation of the central portion (*Bh*), which protrudes from the glass barrel and also carries a thumb ring and receptacle (*Bk*) for the "plug-in" cord of the cathode connection. Further protection for the needle is effected by a rustless steel coil spring on the guide shaft (*Bc*), clamped with a rather tightly fitting but movable band (*Bb*) around the glass barrel. This spring automatically draws the needle back into the cannula at all times, except when the needle is forcibly protruded. To guard against accidental protrusion of the needle during sterilization or transit, a movable locking lever (*Bd*) is provided at the upper end of the guide rod. The glass barrel is marked in millimeters for measurement of the motion of the needle. Further adjustment in the length of protrusion is quickly obtained by forcing the movable band up or down the barrel the desired amount. The cannula works satisfactorily without insulation; it can of course be enameled or made of glass, quartz or bakelite, but no advantage has been gained by many attempts in this direction.

USE OF THE INSTRUMENT

All the localization by tracer bubbles of hydrogen and a major part of the treatment are satisfactorily performed with this instrument, because the sclera does not seem to lose fluid and the vessels do not bleed when punctured with this extremely fine, well polished, practically nontapering needle. The slight loss of current from the needle to the cannula does not in any way affect the reading of the meter, but on account of the diminution in the surface area of the needle, a dose of 1 milliampere for one second is used. None of these iridium-platinum needles has ever been broken, even when severely bent.

During the work of localization with cathodal hydrogen bubbles after the sclera is exposed, it is important to avoid any uncertainty as to which scleral puncture corresponds to each group of bubbles, as observed ophthalmoscopically within the eye. With no handicapping leakage to fear from the extremely fine punctures made with the device just described, one is not forced to work so fast as Vogt described; therefore I depart from his method of making three preliminary punctures before ophthalmoscopic examination. The first puncture is observed, and the length as well as the location of the needle is corrected at the second puncture. Thus, one may arrive at the center of the tear without obscuring it with bubbles due to punctures which slant off center or are unnecessarily deep. If each localizing scleral puncture is marked with ink or diathermy as it is made, the orientation of scleral marks with retinal hydrogen bubbles is much more easily maintained. Also during the early stages of treatment, following localization, the softening of the eye is carefully avoided by use of this extremely fine needle, unless loss of fluid is necessary in order to give a better presentation of the tear. When almost enough treatment has been accurately applied, a larger needle, 7/1,000 inch (0.179 mm.) in diameter, may be used to complete the treatment and provide more drainage if that is considered necessary. My experience does not indicate that drainage is necessary if all the tears are correctly or successfully treated.

The cannula and trocar needle of this device still perform satisfactorily even if given as sharp a curve as a right angle bend on a circle

of 3 mm. radius. If such a curve is placed in the cannula (with a crescent forceps) at the pronged tip, the needle enters the eye on a mild curve all right for the 1.5 to 3 mm. penetration I have used for treatment of a macular hole. If the bend is from 2 to 8 mm. back of the tip the needle enters the eye as a straight needle of corresponding length. By insulation of a cannula of this type with rubber tubing or enamel, it may be employed farther back on the eyeball than a straight needle. In fact, the curved cannula bent for either a short straight or a short curved needle may be used on the temporal side under direct observation at the macula, with minimal if any damage to the ciliary nerves and vessels. Further, it is not difficult to observe ophthalmoscopically the penetration of the curved needle into the vitreous, even when the insulated tip is placed 1 or 2 mm. back of the equator. This is more difficult but possible also at the macula. This makes a startlingly interesting picture, owing to the magnification by the ocular media, and it contributes to more accurate localization in some difficult situations. But the prongs of the cannula must be kept as sharp as needles and slightly set like saw-teeth to prevent any slipping on the sclera.

The needle in this device is very delicate and requires just as much attention and care as a cataract knife, but it has so raised the percentage and quality of "cures" previously obtained in my work that I always keep three or four of these devices available at each operation for separated retina.

Ophthalmologic Review

EDITED BY DR. FRANCIS HEED ADLER

UVEOPAROTITIS (HEERFORDT)

REPORT OF A CASE

HOWARD PRICE FOLGER, M.D., C.M.
KINGSTON, CANADA

The essential features of the syndrome to be discussed are bilateral parotitis and uveitis, often associated with paralyses of cranial nerves, usually of the seventh nerve. The parotitis is of a chronic, painless type with a tendency to progress to resolution without suppuration.

The uveitis in many cases is of a nodular type, resembling tuberculosis. The ocular symptoms may include keratitis, ciliary congestion, synechiae and deposits on the back of the cornea and the anterior surface of the lens and opacities of the vitreous. Optic neuritis, cataract and glaucoma have also been noted. Other symptoms included in the syndrome less frequently are malaise and gastric disturbance, erythematous rashes (occurring usually on the extensor surfaces of the legs and arms), rheumatic pains, paresthesia, dryness of the mouth, polyuria without sugar in the urine and paralysis of other cranial nerves than the seventh. A slight fever is usually present during part of the course.

The disease runs a chronic course, and one of its features seems to be the irregularity in the onset of symptoms. Often there is a prodromal period of malaise, sometimes with gastric upset, which is variable in its duration, and the other symptoms may appear in any order. Sometimes the swelling of the parotid is the first symptom, sometimes the ocular condition. Usually the facial paralysis, when it occurs, follows the parotitis, but in several cases it has preceded it by varying lengths of time. In some cases the lacrimal or submaxillary glands have also been involved.

REPORT OF CASE

History.—H. M., an unmarried woman aged 34, formerly a teacher, for the past two years had stayed at home with her parents. The patient had had chickenpox. Her brothers had mumps in childhood, and she thought that she had the disease at the same time.

From the Department of Ophthalmology, Queen's University Faculty of Medicine.

The patient had experienced numbness of the hands on waking during the night, of moderate severity and causing little discomfort, for several months prior to the onset of the present illness. On the morning of March 13, 1933, she awoke with headache, generalized aching and soreness throughout the body and general malaise. No soreness of the throat, rash, cough, nausea or vomiting was present. The condition persisted for a week and a half without appreciable change. On March 24 the left arm became somewhat weak and lame, and four days later (March 28) severe pain throughout the left arm appeared. It was steady and worse at night and kept the patient awake.

Coincidentally with the appearance of pain, the patient noticed on awakening in the morning that the left side of the face was numb and distorted, with the mouth drawn to the right side, and that the left eyelid would not close. The pain in the arm persisted; the condition of the face improved slightly, and two days later a physician was called. He prescribed pills (which the patient blamed for the gastric disturbances which followed). On April 2 she awoke feeling nauseated, and nausea and vomiting persisted all day. The pain in the arm continued. The condition persisted for a week, during which time the patient was up and about. On April 12 she was forced to stay in bed, to which she was confined for five weeks (till the last week of May). The facial palsy had cleared entirely, but the pain in the arm was still present, as was also the nausea. During the time the patient was in bed the pain was also present at times in the back and in both knees.

After being in bed about a week, she awoke one morning with complete loss of sensation in the arms and trunk from the neck to the waist. She did not remember noticing any sharp line of demarcation or bands of hyperesthesia, and the other parts of the body were unaffected. The sensation gradually returned and was normal in about a week.

Early in May a rash appeared, first noticed on the lateral surface of the upper part of the left arm. The rash consisted of discrete small red papules, with no soreness, itching or discomfort. It was limited to the extensor surfaces of the arms and was present to a slight degree on the back between the shoulders. It disappeared in about three days.

Two weeks later the patient suffered from an attack of severe pruritus, which was worse at night. It was not localized to any part and caused much distress.

In addition to the aforementioned symptoms, the patient noticed almost from the first unusual dryness of the mouth and, for the first few days, marked craving for salt.

She was up and about again about June 1 and felt considerably better. The gastric disturbance showed improvement, but the pain in the arm was still marked at times.

About June 7 she was troubled with polyuria, which lasted about two weeks, and later in the same month tachycardia appeared.

In the middle of July she went to Niagara Falls, where she stayed until late in August. While there, she was submitted to blood tests, determination of the basal metabolic rate and other laboratory examinations and was given general treatment for rehabilitation. About the first of August the left eye became inflamed and somewhat dim. An oculist was consulted, who assured her that there was no organic lesion. After returning home she felt better, although there were still soreness and weakness in the left arm and wrist.

On October 1 she noticed that objects seemed blurred and indistinct when she awakened. This condition persisted but did not cause her any great discomfort.

On November 1 she noticed by accident that there was a swelling in the region of the left cheek and the left side of the jaw, which were numb.

Two weeks later, on November 15, the eyes became irritated and sore, and vision was much worse. The patient came to me for advice as to the condition of the eyes. At this time she was unaware of a slight swelling which was present in the region of the right parotid. She was admitted to the hospital for examination on December 8.

Examination of the Eyes.—Vision in the right eye was 20/80, and in the left, 2/200. It was not improved with the use of lenses. The pupils were regular and rather large. They reacted to light and in accommodation. The movements of the eyes were full in all directions.

Slight pericorneal injection was noted, more marked in the left eye. There were a considerable number of grayish-yellow, dotlike opacities scattered through the deeper layers of the cornea. In the left eye some of these opacities had assumed the form of two *C*'s where they had coalesced. In the right eye there was one *C*-shaped figure. There were many pigment spots on the back of the cornea and the anterior surface of the lens of the left eye. The right eye also showed similar but less marked involvement.

Both irides dilated readily with the instillation of a 1 per cent solution of atropine. No nodes of any kind were seen on the irides, and there were no synechiae. The vitreous of both eyes was full of opacities, and the fundi could not be seen.

The visual fields were normal. No scotoma was present.

Tension in the right eye was 25 mm. (Schiötz) and in the left eye, 25 mm.

Internist's Examination.—On December 11 the patient was examined by Dr. J. R. Third, who made the following report: The higher cerebral and mental functions were normal. There was absence of tremor, fibrillary movements, tic, etc. The cranial nerves appeared normal.

Sensory Functions: On awaking each morning the patient experienced pain in the left shoulder, elbow and wrist. Lifting heavy objects caused pain in the left wrist at any time. Sensibility to touch, pain and temperature was normal. The vibratory sense, stereognosis and results of the compass test were normal.

Motor Functions: The motor reactions were normal.

Reflexes: All the reflexes were normal.

General Physical Examination: The lungs were normal. The heart was normal in size and position. A distinct, soft blowing systolic murmur was heard over the apex and was transmitted into the axilla. The rate and rhythm were normal. The spleen could not be palpated. Nothing abnormal was noted in the abdomen. The thyroid gland was of normal size. No nodules were palpated. The remaining teeth were in fair condition.

Laboratory Data: The results of urinalysis were negative.

The blood count was as follows: red cells, 4,780,000; white cells, 5,200; hemoglobin concentration, 72 per cent; small mononuclears, 17 per cent; large mononuclears, 13 per cent; neutrophils, 63 per cent; eosinophils, 6 per cent; basophils, 1 per cent; transitional cells, none, and myelocytes, none. The Wassermann reaction was negative. The sedimentation time was normal. The basal metabolic rate was normal. The usual blood cultures were all sterile. Long term cultures showed a growth, which is described later in the paper.

Clinical Observations: The temperature varied from 98.4 to 98.8 F. Once it reached 99.2 F.

The pulse rate was from 80 to 90.

The blood pressure was 110 systolic and 80 diastolic.

The reaction to the Mantoux test was negative in the three dilutions.

Roentgenographic Examination: The roentgenogram of the chest presented no evidence of pulmonary tuberculosis or other pathologic condition of the lungs. Roentgenograms of the teeth showed several nonvital teeth, some of which revealed evidence of apical infection.

Course of the Disease.—For the ocular condition atropine, ethylmorphine hydrochloride and hot compresses were used, and as the condition seemed to respond fairly well, this treatment was continued.

Dec. 23, 1933: The pupils were well dilated with atropine. Vision in the right eye was 20/50 and in the left eye, 20/70. Vision in the right eye with a —0.50 D sph. was 20/25— and in the left eye with a —0.75 D sph., 20/40—.

Jan. 10, 1934: Under dilation with atropine vision in the right eye was 20/25 and was not improved with the use of lenses. In the left eye, vision was 20/70 and with a —0.75 D. sph., 20/40+.

The media of both eyes were still hazy but were somewhat clearer than before.

The tension in the right eye was 15 mm. (Schiötz) and in the left eye, 25 mm.

The swelling of the right parotid had almost subsided. The left parotid was somewhat swollen.

Dryness of the mouth and pain in the left arm were present.

January 24: The right parotid was normal, and the left was slightly enlarged.

The right cornea showed discrete whitish spots, and several were present on the left cornea. In each cornea the *C*-shaped figures had broken up into small dots. The vitreous of the right eye was still hazy but was clearing. The disk and fundus seemed normal. The vitreous of the left eye was hazy, and the disk could not be seen clearly.

Under dilation with atropine, vision in the right eye was 20/40— and with a +0.75 D sph., 20/20—. Vision in the left eye was 20/70 and with a +0.75 D sph., 20/50.

The right eye was practically free from inflammation, but some ciliary injection of the left eye was present.

The tension was normal in both eyes. Pigment spots were present on the posterior wall of the cornea of the left eye.

February 5: Under dilation with atropine vision in the right eye was 20/25— and in the left eye, 20/70. Vision was not much improved in either eye with the use of lenses.

Both the corneas were clearing. Discrete small dotlike gray spots were present on both corneas. Many pigment spots were present on the posterior surface of the cornea and the anterior capsule of the lens of the left eye.

Slight fulness of the left parotid was noted.

Pain had disappeared from the left arm and wrist.

April 4: Under dilation with atropine, vision in the right eye was 20/25 and in the left eye, 20/25. With the use of a +0.25 D sph. ⌒ +0.50 cyl., axis 90° for each eye vision was 20/20.

The media of the right eye were clear, but there was slight haziness in the media of the left. The corneas were clear except for a small scar in the cornea of the right eye. Pigment deposits were present on the back of the cornea and on the anterior capsule of the lens of the left eye.

The parotids seemed normal.

The patient had gained 10 pounds (4.5 Kg.) in weight.

July 14: Vision in the right eye was 20/20—2 and in the left eye, 20/20—2. A few deposits were present on the anterior capsule of the lens of the left eye. The patient had gained another 3 pounds (1.3 Kg.) in weight.

November 1: Vision in the right eye was 20/20 and in the left, 20/20.

Very few deposits were present on the back of the cornea and the front of the lens of the left eye.

The patient was in excellent health and weighed 20 pounds (9.1 Kg.) more than she did a year previously.

HISTORY AND ETIOLOGY

The syndrome was first described by Heerfordt in 1909 under the name "febris uveo-parotidea subchronica," in a report of three cases. At the time he referred to similar cases in the literature reported by Darieaux, Péchin and Collomb. He expressed the belief that the disease was an atypical form of mumps. Up to the present about sixty cases have been reported in the literature. Most of these reports are from continental European countries, only four or five coming from America and a few from England.

Souter remarked that most of the later discussions of this condition have been occupied, first, chiefly with the etiology rather than with the existence of the syndrome and, second, with its relation to Mikulicz' disease (or syndrome).

That the condition is due to mumps seems to be out of the question from a study of the literature. The fact that many of the patients had had mumps in childhood and that at the time uveoparotitis occurred they had not been exposed to mumps, the chronic nature of the condition, the frequent bilateral facial paralysis and the absence of orchitis seem to eliminate mumps as an etiologic factor. In many instances also the facial paralysis and iridocyclitis preceded the swelling of the parotid.

Syphilis can be ruled out easily, as in most of the cases the patient was free from this disease.

Diphtheria, though similar to this condition in its paralytic effects, is apparently not the underlying factor.

Mikulicz' disease in many ways seems to be allied to the Heerfordt syndrome, and at times a group of cases of the one disease probably contains instances of the other, as Mikulicz' disease with supervening uveitis gives the same clinical picture as Heerfordt's syndrome except for the lacrimal swelling.

Tuberculosis was held to be responsible for the condition by the majority of authors who reported cases. The iritis, at least, is usually of a type resembling tuberculosis. It is of interest that three of the four patients on whom autopsy was performed died of miliary tuberculosis. One patient died of pernicious anemia, which did not seem

to have any connection with the uveoparotitis. Two of the patients who died of tuberculosis had tuberculosis of the heart, which is a rare condition in itself and may or may not be a coincidence. When biopsy was made of the involved iris or parotid a fibrosing type of tuberculosis was shown in practically all the cases. Organisms, however, have rarely been seen.

The case for tuberculosis has been strongly and ably presented by Garland and Thomson in 1933, and they have termed the condition "uveo-parotid tuberculosis." Souter, also, was inclined to the same opinion. In both the cases reported by these authors autopsy was performed, and, as already mentioned, miliary tuberculosis and tuberculosis of the heart were shown.

In the case reported by Daireaux and Péchin the condition was thought to be of toxic origin.

Heerfordt pointed out that paresis of the cerebrospinal nerves, uveitis and involvement of the optic nerve may occur as complications of mumps. He further remarked that in the cases of Collomb and Daireaux and Péchin the same syndrome was shown as in his three cases and that no factors pointed to mumps as the exciting cause. He concluded that the cases were instances of a definite clinical entity, which he termed "febris uveoparotidea subchronica." He expressed the belief that it might be an atypical form of mumps.

In Schou's case, reported in 1914, the condition was at first diagnosed as "tuberculous iritis" but later was found to correspond to the syndrome described by Heerfordt.

Lehmann in 1916 stated that the condition might be a form of tuberculosis. In one case (already mentioned) in which autopsy was performed, pernicious anemia was shown. In another case there was tuberculosis. Of twelve cases which Lehmann mentioned there was definite tuberculosis in three. Tuberculous tissue was observed in the iris of one patient and in the cervical glands of another.

Kuhlefelt reported a case in 1916. No evidence of tuberculosis was found in the patient, but the father died of the disease.

Mackay in 1917 reported a case of a condition which he stated was "quite unlike either Parinaud's or Mikulicz' disease." He expressed the belief that mumps is not the sole cause of the condition.

Fuchs stated that Heerfordt's uveoparotitis is a form of tuberculosis and that syphilis can also induce the disease.

In 1918 Bang reported two cases. Observations at biopsy showed endothelial cells and giant cells in the nodules of the iris. He expressed the opinion, however, that uveoparotitis is connected with Mikulicz' disease and that the pseudoleukemia is the etiologic factor. One of his patients died later, and autopsy showed miliary tuberculosis.

No.	Author	Date	Sex	Age, Yrs.	Prodromes	Duration of Illness	Temperature	Condition of Parotids	Involvement of Eyes
1	Daireaux and Péchin (reported the case independently)	1899	M	22	Indefinite pain	.....	.....	Bilateral swelling	Ciliary involvement with plastic iritis; posterior synechiae
2	Collomb.....	1903	M	29	Digestive disturbance	.....	.....	Bilateral swelling	Iridocyclitis; hyperemia of disk (preceding swelling of parotid)
3	Cutler.....	1904	F	20	.....	.....	.....	Bilateral swelling 1 year; swelling of lacrimal and submaxillary glands	Keratitis; nodular iritis; cyclitis
4	Heerfordt.....	1909	M	11	Malaise; anorexia	.....	Slightly elevated	Bilateral swelling appearing 3 weeks after first ocular symptoms	Iridocyclitis; optic neuritis in both eyes; deposits on posterior surface of cornea; numerous synechiae (duration 2 months); opacities of vitreous
5	Heerfordt.....	1909	M	14	Paleness and fever 1 month	.....	Slightly elevated	Bilateral swelling lasting 1 month and then disappearing gradually	Iridocyclitis; synechiae; nodules; deposits on posterior surface of cornea
6	Heerfordt.....	1909	M	27	Malaise and weakness 5 months	.....	Slightly elevated	Bilateral swelling	Iridocyclitis; bilateral synechiae; corneal deposits; opacities of vitreous
7	Brewerton.....	1910	M	17	Rash on face and arms	.....	.....	Bilateral swelling; also slight swelling of submaxillary glands	Cyclitis; keratitis punctata; posterior synechiae
8	Schou.....	1914	M	13	.....	Several months	Slightly elevated	Bilateral swelling; swelling of lacrimal glands	Nodular iritis; bilateral opacities of vitreous
9	Kuhlefelt.....	1916	F	21	.....	.....	Slightly elevated at times	Bilateral swelling	Iridocyclitis, optic neuritis and retinitis of right eye; later iritis of left eye
10	Lehmann.....	1916	..	..	.....	.....	.....	.....	.....
11	Leeksma.....	1916	M	14	.....	Months	.....	Bilateral swelling	Iridocyclitis; optic neuritis
12	Leeksma.....	1916	F	28	.....	Few months	.....	Bilateral swelling	Iridocyclitis; vitreous opacities
13	Leeksma.....	1916	F	15	.....	Months	.....	Bilateral swelling	Iridocyclitis
14	MacKay.....	1917	F	30	Cold and cough 2 weeks; malaise and pains in stomach with nausea	Over 1 year	.....	Bilateral swelling	Paralysis of ciliary body; uveitis; keratitis punctata of cornea; hazy vitreous
15	Fuchs.....	1918	F	..	Gastro-intestinal upset	9 months	.....	Bilateral swelling; swelling of lacrimal glands	Iridocyclitis
16	Fuchs.....	1918	F	47	Rheumatism	Months	.....	Bilateral swelling; swelling of lacrimal glands	Iridocyclitis; vitreous opacities
17	Fuchs.....	1918	F	40	Rheumatism	Months	.....	Bilateral swelling; swelling of lacrimal glands	Iridocyclitis; vitreous opacities

...rotitis Collected from the Literature

Nervous Symptoms	Other Manifestations	Comment
...aralysis of right side of ...ce (3 weeks' duration) ...receding ocular symptoms	.....	Swelling of parotid and iritis thought of toxic origin and facial paralysis not due to pressure of parotid on nerve; stated that paralysis resembled that of diphtheria
.....	.....	"Such a uveitis, however, is of endogenous origin, syphilitic, tubercular, lymphoid, or from some infection not at present to be classified"
.....	.....	One of Heerfordt's patients found to have tuberculosis 7 years later
...aralysis of right side of ...ace; dysphagia	Pain in right knee; nasal hemorrhage	
...ysphagia; nasal voice; ...due to paresis of soft ...palate); paralysis of left ...recurrent nerve; paralysis ...f right side of face	Thirst; polyuria; dryness of mouth	Diphtheria bacilli found on culture from throat; in original paper Heerfordt stated that the condition in his cases was due to unknown infectious disease
.....	Dryness of mouth	Rash (erythema nodosum) on extensor surface of legs
.....	Ganglion-like formations on dorsal surface of both hands	Condition diagnosed first as "tuberculous iritis," later placed in category of Heerfordt's disease
....	.....	Father died of tuberculosis; no tuberculosis observed in patient; history of mumps in childhood
...Facial palsy	.....	In 9 of 12 patients nothing to suggest tuberculosis or predisposition to it; in 3 patients definite tuberculosis; tuberculosis observed microscopically in iris of one patient and in cervical glands of another
.....	.....	
...Paralysis of seventh nerve		
...Facial palsy		
.....	.....	"On the lower part of the right cornea one larger, grey, greasy spot composed of a small chain of more recent confluent deposits, shaped like a letter 'C' or one of Landholt's vision test figures . . . The case was quite unlike either Parinaud's or Mikulicz's diseases." Author agreed with Heerfordt that some other etiologic factor than mumps may be involved; stated that the case for mumps as the sole cause of uveoparotitis is not yet proved
.....	.....	"A special form of tuberculosis of the iris is the febris uveoparotidea of Heerfordt. The disease can be induced by lues also"
....	.....	
.....	.....	

No.	Author	Date	Sex	Age, Yrs.	Prodromes	Duration of Illness	Temperature	Condition of Parotids	Involvement of Eyes
18	Bang.....	1918	M	13	.....	.....	.....	Bilateral swelling	Iridocyclitis
19	Bang.....	1918	F	15	.....	.....	.....	Bilateral swelling	.....
20	Weve.....	1918	M	14	.....	Months	.....	Bilateral swelling	Iridocyclitis; optic neuritis; nodular iritis
21	Weve.....	1918	F	28	.....	Months	.....	Bilateral swelling	Iridocyclitis; optic neuritis; nodular iritis
22	Weve.....	1918	F	15	.....	.....	.....	Bilateral swelling	Iridocyclitis
23	Thomsen.....	1919	F	18	.....	.....	.....	Bilateral swelling	Iridocyclitis
24	Ramsay.....	1921	F	31	Eyelids puffy and ankles swollen on awaking one morning	Months	.....	Bilateral swelling	Iridocyclitis
25	Coppez.....	1922	..	..	.....	.....	.....	Bilateral swelling; swelling of lacrimal glands	Iridocyclitis
26	Feiling and Viner	1922	F	21	Malaise	Months	.....	Bilateral swelling	Iridocyclitis; pupils inactive in accommodation; opacity of vitreous
27	Berg.....	1923	F	23	.....	.....	.....	Bilateral swelling	Iridocyclitis
28	MacBride.....	1923	F	43	Yellow tint of skin and itching of face and forehead; pain in both legs and sensation of "pins and needles" from feet to hips; weakness of legs (2 mos.)	Several months	Slightly elevated	Bilateral swelling	.....
29	Sciall.....	1923	F	24	.....	8 months	Slightly elevated	Bilateral swelling	Retinochoroiditis; corneal deposits
30	Altland.....	1924	M	40	Chronic myocarditis; pains in joints; nausea; eczematous rash	.....	Slightly elevated	Bilateral swelling	Iridocyclitis; synechiae; opacities of vitreous; glaucoma
31	Critchley and Phillips	1924	F	51	Arthritis; dryness of mouth	2 years or more	Slightly elevated in evening	Bilateral swelling	Reaction in accommodation lost; ptosis; hazy cornea; pigment in anterior capsule of the lens
32	Jackson..... (Mikulicz' disease ?)	1925	F	27	.....	Over 1 year	.....	Bilateral swelling; swelling of lacrimal glands	Lardaceous deposits on corneas; opacities of vitreous; synechiae; cataract of left eye
33	Parker.....	1926	F	55	Shivering and pains	.....	No elevation	Bilateral swelling	Semidilated pupils; no reaction in accommodation

is Collected from the Literature—Continued

Nervous Symptoms	Other Manifestations	Comment
.....	.....	Observation of giant cells and epithelioid cells in iris in 4 cases was thought at the time to indicate tuberculosis as the origin, but Bang advised classifying it in the group of cases of pseudoleukemia; later one of the patients died, and autopsy showed miliary tuberculosis
.....	.....	
.....	.....	Weve stated disease was not due to syphilis, tuberculosis or pseudoleukemia; in one case relation to epidemic parotitis was proved; Weve thought at first the disease was due to mumps
Palsy of right side of face (came on before swelling of parotid)	.....	
Palsy of left side of face	.....	Van der Hoeve later observed tuberculosis in preauricular gland in one of Weve's cases
Unilateral facial palsy	.....	Patient improved with treatment with tuberculin; author thought tuberculosis responsible in a number of cases
Paralysis of left side of face	Intercostal pain; skin of chest hyperesthetic; difficulty in swallowing (paralysis of soft palate)	Neither mumps nor diphtheria could be considered a causal factor
.....	.....	Nodule excised from conjunctiva showed tuberculous structure; No organisms of tuberculosis observed
Paralysis of right side of face appearing early before the parotitis; later palsy of left side of face; glaucoma	Ankle jerks absent; knee jerks lost; numbness of hands; erythematous rash on arms and legs	Paralysis of right side of face was first symptom to attract notice; author stated mumps was not the cause; "the condition was probably caused by a generalized toxaemia and consequently the eye infection was primarily vascular and localized in the ciliary body"; author considered the involvement of the nerve to be toxic neuritis
.....	.....	Tuberculosis considered the cause; (40 cases reviewed)
Paralysis of right side of face; later of left side	Slight deafness of right ear; palsy of right side of face; slight deafness of left ear with palsy of left side of face; dysphagia; paresthesia	Condition not due to mumps; "there can be no doubt that uveo-parotitic paralysis is of a toxic or toxi-infective nature but its cause has not yet been discovered"
.....	.. ..	Findings at medical clinic showed no basis for diagnosis of active tuberculosis; enlargement of glands at hilus of lungs; Schall stated the patient was cured by treatment with tuberculin; called disease "uveo-parotitis subchronica tuberculosa"
Palsy of right side of face	.....	No tuberculous process in the internal organs, according to the internist; uveitis atypical of tuberculosis in spite of the "golden yellow" nodules; Altland expressed the belief that the facial paralysis was due to toxin analogus to the paralysis in late stages of diphtheria and that it pointed rather to a particular causative agent of Heerfordt's disease; microscopic observations on section of iris, however, indicated tuberculosis; in spite of this Altland believed that the disease was a unified symptom complex caused by an unknown agent
Slight impairment of seventh nerve	Dysphagia; some atrophy of muscles	Ocular symptoms came on about 18 months after swelling of parotids began; ovaries had been removed years before; author expressed the belief that the disease was a chronic infection of unknown etiology and that pulmonary signs, temperature and family history suggested tuberculosis
Paralysis of right side of face	Dryness of mouth	Glands treated with roentgen rays with marked improvement; eyes later given roentgen treatment, which seemed to help materially
Paralysis of right side of face (possibly also slight palsy of left side)	Dryness of mouth; pseudoptosis of left side; papular rash on forearms	"We may perhaps consider the condition to be chiefly an infective multiple neuritis, showing certain lesions in other tissues, such as parotitis, uveitis, and skin troubles. The present disorder shows much resemblance to E. lethargica and to diphtheria, and in all . . . the loss of accommodation in the eye is a very frequent and early symptom"; author stated that Mikulicz' disease need not concern one, as it presents such a different picture; "the skin rashes point to a general blood infection"

No.	Author	Date	Sex	Age, Yrs.	Prodromes	Duration of Illness	Temperature	Condition of Parotids	Involvement of Eyes
34	McCulloch.....	1927	F	27	.....	.....	.....	Bilateral swelling	Pupils sluggish to light and in accommodation; iridocyclitis; synechiae; deposits on back of cornea and anterior capsule of lens in each eye; opacities of vitreous
35	Hamburger and Schaffer	1928	M	12	Headache and fever	Several months	Elevation	Bilateral swelling	Iridocyclitis
36	Cavara.....	1928	F	55	.....	.....	.....	Bilateral swelling; swelling of lacrimal glands	Iridocyclitis
37	Souter.....	1929	M	40	Nausea and vomiting 2 weeks; later weakness and cough	.....	Slight elevation except in fifth and sixth weeks; reached 104 F.	Bilateral swelling	Iridocyclitis; iridocycloplegia
38	Merrill and Oaks	1931	F	43	Malaise 2 months; arthritis; erythematous rash on legs; dryness of mouth	2 years and 10 months	Slightly elevated	Bilateral swelling; slight swelling of submaxillary glands	Iridocyclitis; corneal deposits; transitory swelling of lens; retinochoroiditis
39	Garland and Thomson	1933	F	28	"Influenza and bronchitis"; rheumatic pains	.....	Slightly elevated	Bilateral swelling	Iridocyclitis; pupils unequal and fixed both to light and in accommodation; deposits on cornea and anterior capsule of lens; hazy vitreous
40	Mohn.....	1933	F	28	Tuberculous peritonitis	.....	Slightly elevated	Bilateral swelling	Bilateral uveitis; nodules on iris; corneal opacities
41	Garland and Thomson	1934	F	31	"Influenza" in December 1931 and February and April 1932; lassitude; loss of weight; anorexia	.....	Slightly elevated	Bilateral swelling	Iritis; hazy vitreous; pupils unequal and fixed; conjunctivitis; posterior synechiae; keratitis punctata
42	Garland and Thomson (case referred by R. S. Lawson)	1934	F	54	.....	.....	.....	Bilateral swelling	Conjunctivitis (left eye); bilateral iritis
43	Davies.....	1934	F	25	Swelling and discoloration of knees	.....	98.2-101 F.	Bilateral swelling	Circumcorneal and conjunctival injection; keratitis punctata; pupils irregular
44	Tait.....	1934	M	27	.....	.....	.....	Bilateral swelling	Ciliary injection; keratitis punctata; left cycloplegia; posterior synechiae; hazy vitreous

is Collected from the Literature—Continued

Nervous Symptoms	Other Manifestations	Comment
Palsy of both sides of face	.....	No likelihood of exposure to mumps
.....	.....	"It is certain that tuberculosis is not the sole etiologic agent of febris uveoparotidea"
Dysphagia	.....	Patient had had cough for years; clinical signs of tuberculosis found in lungs; injection of tuberculin followed by focal and general reactions; portions of lacrimal glands implanted into anterior chamber of eye of 3 rabbits, 2 of which were infected and died; in the third animal tissue was absorbed without pathologic change; macerated pieces of lacrimal gland injected into guinea-pigs; 2 gave negative reactions and the third showed wasting and died of tuberculosis; much caseation at site of injection; sections of the parotid showed increase in fibrous tissue, with little surviving gland and many endothelioid tubercles surrounded by zones of lymphocytic infiltration; tubercle bacilli were not observed, and giant cells were scanty
Paralysis of right side of face	Joint pains; absence of knee jerks; dryness of mouth	Souter stated that uveoparotitis may be considered as distinct from mumps and that discussion has centered around the etiology rather than the existence of a clinical entity; he believed tuberculosis to be the cause and stated: "the mechanism that may be assumed is that the absorption from tuberculous bronchial or even mesenteric glands causes the parotitis and the uveitis and that in the worst varieties of iridocyclitis actual bacilli, possibly of a non-virulent type, as suggested by Wilmer, may reach the eye"; miliary tuberculosis found in Souter's case 7 months after first examination; autopsy showed miliary tuberculosis with tuberculous infiltration of the wall of the left ventricle
No involvement	Sphenoiditis; pleural effusion; erythema nodosum	Pleurisy of 1 week's duration was followed by effusion of straw-colored fluid on left side; Pirquet reaction, roentgenogram and results of internist's examination were negative for tuberculosis
.....	Loss of voice; sensation of "pins and needles" in feet; thirst; polyuria; progressive weakness; distaste for sweets; tachycardia	Pirquet reaction negative; roentgenogram of chest revealed nothing abnormal; autopsy showed: miliary tuberculosis of pericardium, tuberculosis of myocardium, old tuberculosis of mesenteric glands and tuberculosis of parotid and submaxillary glands; tuberculosis of kidney also shown on subsequent examination; tubercle bacilli were not observed; "In all the cases in which biopsies have been performed, whether from the parotids or from the irides, the histological features have been exactly similar, namely, an endothelial fibrosing tuberculosis in which caseation is absent and tubercle bacilli are not found"
Bilateral paralysis of the face; bilateral deafness	Swelling of lacrimal, cervical and submaxillary glands; weakness of limbs; Rombergism	Tuberculosis of lungs also present
Facial palsy; paralysis of right arm; sensory ataxia; bilateral incomplete nerve deafness	Unable to stand or walk; weakness of hands; dryness of mouth; glove and stocking area of impairment of sense of pain; erythematous rash of lower parts of legs; deafness of middle ear and partial nerve deafness	Microscopic examination of tissue from area of rash showed active tuberculous lesion of the dermis; no organisms seen; gold therapy instituted, and from this time deafness and ocular symptoms improved; roentgenograms showed miliary tuberculosis of lungs; authors stated the polyneuritis was due to tuberculous toxin circulating in the blood
Palsy of left side of face	.....	Biopsy of parotids showed tuberculous parotitis, but no organism was observed; roentgenogram of the chest gave suspicious evidence of tuberculosis
Palsy of left side of face	.....	Iritis seemed to be tuberculous, which "supports the suggestion that the syndrome is tuberculous in origin"
Bilateral facial palsy; weakness of muscles of palate; paralysis of right vocal cord	Hoarse voice; pain and weakness in right leg	Tait expressed the belief that this condition was more likely due to a circulating toxin than to tuberculosis

Weve in 1918 expressed the belief that the condition is not due to tuberculosis, syphilis or pseudoleukemia. He thought at first that mumps might be the cause, but later he was inclined to believe that the disease is due to an unknown agent. Biopsy of material from the parotid showed a tuberculosis-like process, and Weve suggested that the condition might be termed "paratuberculosis." He believed that the use of radium helped the condition.

Thomsen reported a case in 1919 in which improvement took place with treatment with tuberculin, and he expressed the belief that the condition is tuberculous.

Gjessing at first thought that syphilis was the cause, but later he was inclined to believe it to be tuberculosis.

Müller in 1920 reported a case in which biopsy of material from the parotid showed endothelioid cells characteristic of tuberculosis.

Ramsay in 1921 expressed the belief that neither mumps nor diphtheria can be considered causal factors.

Coppez in 1922 reported a case in which a nodule excised from the conjunctiva showed tuberculous structure.

Feiling and Viner in 1922 reported a case in which they believed that the cause was generalized toxemia.

Berg in 1923, after a review of forty cases, stated that he considered tuberculosis to be the cause.

MacBride in 1923 stated that "there can be no doubt that uveoparotitic paralysis is of a toxic or toxi-infective nature, but its cause has not yet been discovered."

Schall in the same year (1923) expressed the opinion that in this case the disease was cured by tuberculin and that it should be called uveoparotitis subchronica tuberculosa.

Altland in 1924 stated that he did not think that the condition was tuberculous. He expressed the belief that the facial paralysis is due to a toxin analogous to that producing the paralysis associated with the late stages of diphtheria and that it points rather to a particular causative agent. Microscopic examination of a piece of excised iris in this case rather indicated tuberculosis, but Altland still believed the disease to be a unified symptom complex due to an unknown agent.

Critchley and Phillips in 1924 stated that they considered the disease to be a chronic infection of unknown etiology. They expressed the belief, however, that certain pulmonary signs and the history and temperature suggest tuberculosis.

Reimers in 1926 expressed the belief that a form of tuberculosis is the cause of the condition, and biopsy of material obtained from the parotid in his case showed endothelioid cells characteristic of tuberculosis.

Parker in 1926 stated: "We may perhaps consider the condition to be chiefly an infective multiple neuritis, showing certain lesions in other tissues, such as parotitis, uveitis, and skin troubles. . . . The skin rashes point to a general blood infection."

Cavara in 1928 reported an interesting case in which involvement of the lacrimal glands was also shown. In this case also biopsy of the parotid showed endothelioid cells like those which occur in tuberculosis.

Hamburger and Schaffer in 1928 stated that tuberculosis is not the sole etiologic factor.

Souter in 1929 reported an interesting case, which has already been mentioned. He expressed the belief that tuberculosis is the cause and stated:

> The mechanism that may be assumed is that absorption from tuberculous bronchial or even mesenteric glands causes the parotitis and uvetitis and that in the worst varieties of irido-cyclitis, actual bacilli, possibly of a non-virulent type, as suggested by Wilmer, may reach the eye.

In speaking of his case, Souter remarked:

> The present case has a special interest in that it was watched over a period of seven months and was found to show no very positive features of tuberculosis apart from increased root shadows in the lungs up to the time of discharge from the Hospital, four months before death, yet at autopsy one found miliary tuberculosis associated with enlarged bronchial glands, and the very unusual condition of a widespread tuberculous infiltration of the wall of the left ventricle without any apparent involvement of the epi- or endocardium or the walls of other cavities. Sections of the lungs and of the bronchial glands showed the features of chronic lymphatic tuberculosis of some standing, as well as the miliary tubercles. It is instructive to find a negative (Von Pirquet) reaction six months before the fatal issue, where later one finds gross tuberculous disease of bronchial glands, lung and myocardium.

Merrill and Oaks, in the report of a case in 1931, stated:

> This group of cases forms a well defined entity. A further search for evidence of tuberculosis should be made, but, in the opinion of the authors, the weight of evidence to date points, in so far as etiology is concerned, to some specific virus, bacterium or agent yet unknown.

Garland and Thomson in 1933 reported a case (already mentioned) of more than usual interest. Its similarity to that of Souter's has already been pointed out. In both cases the results of clinical examination were negative for tuberculosis, yet autopsy showed miliary tuberculosis. The comprehensive report of the authors includes a review of the literature and the important points in a large number of cases. After a thorough analysis of forty-seven cases, including their own, they concluded:

> Uveo-parotid fever (Heerfordt) is a well-defined clinical and pathological entity, characterized by bilateral uveitis and parotitis, pursuing a chronic course with a

well-marked tendency to spontaneous recovery. Death, in the rare instances in which it occurs, is due to miliary tuberculosis. Facial palsy occurs in half the cases, and in one-third there is slight pyrexia at some stage. The cause of the condition is tuberculosis of a particularly fibrosing and non-caseating type, and in a certain number of cases the myocardium is similarly affected. Manifestations of polyneuritis are infrequent and form no essential part of the disease. "Uveo-parotid tuberculosis" is suggested as a more suitable title than either "febris uveo-parotidea subchronica" or "uveo-parotitic paralysis."

More recently (1934), Garland and Thomson reported two cases of the same condition. In one of the cases considerable involvement of the nerves was shown, including palsy of the right side of the face, paralysis of the arms, sensory ataxia and incomplete nerve deafness. The patient received therapy with a gold compound, and the authors stated that from the beginning of the treatment he showed improvement. Microscopic examination of skin taken from the area covered by the rash showed a tuberculous lesion but no organisms. In the second case biopsy of the parotids showed tuberculous parotitis, but again no organisms were seen.

Garland and Thomson also referred to a case reported by Mohn in 1933, in which he (Mohn) considered the condition to be of tuberculous origin.

Davies reported a case which he thought supported the theory of a tuberculous etiology.

Tait, however, took issue on this point in the report of a case. He pointed out that Garland and Thomson based their contention of a tuberculous etiology on the following evidence:

1. Postmortem observations of miliary tubercles and tubercles of the heart (four investigators).

2. Results of biopsy with histologic evidence of tuberculosis in (*a*) the iris (four observers), (*b*) the bulbar conjunctiva (one observer) and (*c*) the parotid (five observers).

3. Nodules in the iris (five observers).

4. Focal reaction to tuberculin (two observers).

5. Tuberculosis of the lung with the presence of tubercle bacilli in the sputum (one observer).

Against this evidence he stressed the following facts:

1. Pathologic observations. The tubercle bacillus has never been demonstrated by any investigator in histologic sections prepared from the iris, parotid or lymphatic glands.

2. Ocular condition. Except for the nodules, characteristic of tuberculosis, syphilis or leprosy (the last two of which may be excluded), the course of the ocular lesion is not characteristic of tuberculous dis-

ease of the eye, as the condition ordinarily tends toward good recovery of function, whereas in tuberculous disease of the eye the reverse is the rule.

3. Nervous lesions. Garland and Thomson explained the facial palsy on the basis of pressure on the nerve as it leaves the stylomastoid foramen. Davies pointed out that in a case reported by Mohn in 1933 the lesion was somewhere between the geniculate ganglion and the branching of the chorda tympani (i. e., in the bone itself, pressure from the parotid, which incidentally was not yet enlarged, thus being excluded). He expressed the belief, therefore, that the neuritic manifestations may be due to a circulating toxin, which is not a feature of tuberculosis.

Tait summarized his statements as follows:

> Thus it will be readily seen that although there are features common alike to uveo-parotitis and tuberculosis, yet the composite picture of the signs of uveo-parotitis bears but a slight resemblance to tuberculosis. While there appears to be a special tendency towards systemic tubercle amongst those exhibiting the uveo-parotitic syndrome, there is a significant omission in the vast literature of tuberculosis of reference to these manifestations.
>
> Weve perhaps adopts the wisest attitude in considering that it would become more certain that we are dealing not with tuberculosis but with an unknown aetiological agent, which from the tubercle-like histological findings can be termed para-tuberculosis. It is significant that cases are not infrequently met with where there is no suggestion of latent tubercle, either on clinical grounds or on the family history, and of the half-dozen cases that I have had the opportunity of seeing only in one was there a possible tuberculous taint. I would therefore suggest that in view of these conflicting facts the designation of uveo-parotid tuberculosis is at this stage unjustified.

In an article entitled "Mikulicz Syndrome in Association with Tuberculosis," Rees reported an instance which he considered to fall into the group of cases of uveoparotitis and to support the idea of a tuberculous etiology for the latter group. In this case the ocular lesion was that of choroidoretinitis with central scotoma in the left eye. There were bilateral swelling of the parotid and submaxillary glands and enlargement of the cervical glands. Healed scars on the back and legs resembled those of a healed tuberculid, and there was a previous history of involvement of the chest, probably tuberculous.

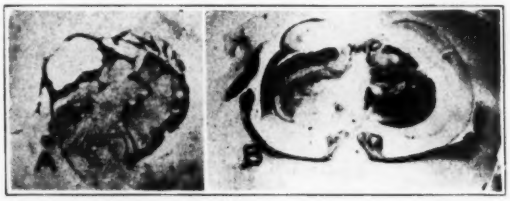
It will be seen from this review that the question of the etiology of uveoparotitis may be stated as follows: Is it tuberculosis or is it due to a cause of which one is yet unaware?

Undoubtedly, there is considerable evidence that the condition may have a tuberculous etiology, but after a careful review of the literature one believes that to be too positive is to express an opinion perhaps a trifle premature.

BACTERIOLOGIC INVESTIGATION

Through Dr. G. S. Melvin, of the department of physiology, and Dr. J. H. Orr, of the department of bacteriology, of the Queen's University Faculty of Medicine, the following investigation of the saliva and blood was made. No conclusions are drawn from this work, and whether the minute gram-positive coccoid organism isolated from the blood of the patient is in any way responsible for the disease is highly conjectural.

Samples of saliva and blood were obtained for investigation. Blood cultures by ordinary methods proved negative. The saliva was examined by means of direct intravenous injections into rabbits. In none of the animals so treated did any symptoms develop. The blood was allowed to clot, and the serum and clot were both investigated. Direct injections of serum were made intravenously into rabbits. In one of these animals paralysis of both hindlegs and ulceration of the cornea developed six months later. The lesions of the cornea had no characteristic features, and microscopic examination of the central nervous system revealed no evident lesion. The clot was broken up and incubated in hormone broth.[1] The



Photographs showing (*A*) an abscess at the lower left pole of the metencephalon and (*B*) the mesencephalon.

culture remained negative till about three weeks had elapsed, by which time some turbidity had developed and smears showed numerous very small gram-positive coccoid organisms.

Injections of this turbid culture were made into three rabbits, with injections of the medium into other rabbits used as controls. The latter animals remained normal. In two of the three test animals symptoms of paralysis developed after from three to four weeks with occasional convulsive bouts, and the rabbits died in a short time. In the third animal similar symptoms eventually developed, with ulceration of the cornea and cataract in each eye, and the rabbit died about five months after the injection. Culture of the blood drawn from the heart a few hours before death yielded similar minute gram-positive coccoid organisms.

In all three instances postmortem examination was made, but the only evidence of any lesion visible to the naked eye was in the third animal, in which a tumor was situated in the caudal portion of the metencephalon. Sections of the cord and brain stem were stained by the Weigert-Pal method (figure). The tumor itself was sharply circumscribed and was evidently a localized abscess. It had caused considerable compression of this part of the brain stem, which apparently accounted for ipsilateral degeneration evident in sections from the mesencephalon

1. Hormone or vitamin broth is prepared by a slight modification of the method described by Murray and Ayrton (J. Hyg. **23**:23, 1924).

and diencephalon. There was much less evidence of degeneration in the myelencephalon and cord. The relationship between the abscess and the antecedent inoculation is conjectural. In view of the symptomatology in cases in man, the parotid and lacrimal glands were also examined, but they appeared normal.

Unfortunately, the laboratory had to be completely dismantled for reconstruction, and in the resulting disorganization the cultures died, so the investigation has had to be suspended.

BIBLIOGRAPHY

Altland, D.: Febris uveo-parotidea, Ztschr. f. Augenh. **53**:113, 1924.

Bang, S.: Chronic Parotitis with Iritis and Facial Paresis, Ugesk. f. læger **80**:571, 1918.

Berg, F.: Om febris uveo-parotidea, Hygiea **85**:401, 1923.

Brewerton, E. W.: Bilateral Parotitis and Cyclitis, Tr. Ophth. Soc. U. Kingdom **30**:148, 1910.

Cavara, V.: Sopra un caso di febris uveo-parotidea subchronica di Heerfordt, Boll. d'ocul. **7**:925, 1928.

Collomb, A.: Iritis ourlienne: Un cas d'iritis ourlienne double, Rev. méd. de la Suisse Rom. **23**:43, 1903.

Coppez, H.: Fever in Uveoparotitis, Bull. Soc. belge d'opht. **6**:118, 1922.

Critchley, M., and Phillips, P.: Uveo-Parotitic Paralysis and Iridocyclitis, Lancet **2**:906, 1924.

Cutler, Colman W.: Symmetrical Enlargement of Parotid and Lachrymal Glands: Nodular Iritis, Tr. Am. Ophth. Soc. **10**:390, 1904.

Daireaux, Pierre: Paralysis faciale et iritis l'origine des neuritis ourliennes, Bull. méd., Paris, 1899, p. 227.

Davies, T. A. L.: Uveo-Parotitis Polyneuritica, Lancet **2**:746 (Oct. 6) 1934.

Feiling, A., and Viner, G.: Iridocyclitis–Parotitis–Polyneuritis: A New Clinical Syndrome, J. Neurol. & Psychopath. **2**:353, 1922.

Fuchs, E.: Am. J. Ophth. **1**:433, 1918.

Garland, H. G., and Thomson, J. G.: Uveo-Parotid Tuberculosis, Quart. J. Med. **2**:157, 1933.

Uveo-Parotid Tuberculosis, Lancet **2**:743 (Oct. 6) 1934.

Gjessing, H.: Febris uveo-parotidea (Heerfordt), Klin. Monatsbl. f. Augenh. **56**:252, 1916.

Hamburger, L. P., and Schaffer, A. J.: Uveo-Parotid Fever, Am. J. Dis. Child. **36**:434 (Sept.) 1928.

Heerfordt, C. F.: Ueber eine Febris uveo-parotidea subchronica an der Glandula parotid und der Uvea des Auges, Arch. f. Ophth. **70**:254, 1909.

Jackson, B. H.: Use of X-Ray in Uevoparotitis, Am. J. Ophth. **8**:361, 1925.

Kuhlefelt, E.: Subchronic Febrile Uveoparotid Inflammation, Finska läk.-sällsk. handl. **58**:867, 1916; abstr., Brit. J. Ophth. **1**:621, 1916.

Leeksma, H. W.: Een geval van febris uveo-parotidea, Nederl. tijdschr. v. geneesk. **2**:1126, 1916; abstr., Lancet **1**:28, 1917.

Lehmann, K.: Om febris uveo-parotidea, Hospitalstid. **59**:137, 1916.

MacBride, H. J.: Uveo-Parotitic Paralysis, J. Neurol. & Psychopath. **4**:242, 1923.

McCulloch, J. D.: Uveo-Parotitis, Tr. Ophth. Soc. U. Kingdom **47**:410, 1927.

MacKay, G.: Uveo-Parotitis with Irido-Cycloplegia, Brit. J. Ophth. **1**:612, 1917.

Merrill, H. G., and Oaks, L. W.: Uveoparotitis (Heerfordt), Am. J. Ophth. **14**: 15, 1931.

Mohn, Arne: Ein Fall von Febris uveo-parotidea (Heerfordt), Acta ophth. **11**: 397, 1933.

Müller, M.: Bemerkungen zu der Arbeit von H. Reith über "Iridozyklitis bei Parotitis epidemica und anderen Speicheldrüsenschwellungen und über ihre Beziehungen zur Tuberkulose," Klin. Monatsbl. f. Augenh. **64**:387, 1920.

Parker, George: Uveo-Parotitic Paralysis, Bristol Med.-Chir. J. **43**:73, 1926.

Péchin, A.: Rev. gén. d'opht. **20**:445, 1901.

Ramsay, Maitland: Cyclitis Accompanied by Swelling of Parotid Glands and Paralysis of Cranial Nerves, Tr. Ophth. Soc. U. Kingdom **41**:194, 1921.

Rees, W. Esmond: Mikulicz Syndrome in Association with Tuberculosis: Report of Case, Lancet **2**:749 (Oct. 6) 1934.

Reimers, O.: Ueber einen Fall von Febris uveo-parotidea und über die Beziehungen zur Tuberkulose, Ztschr. f. Augenh. **60**:30, 1926.

Schall, Emil: Beitrag zur Aetiologie der Uveo-Parotitis subchronica, Klin. Monatsbl. f. Augenh. **70**:350, 1923.

Schou, S.: Demonstration of a Patient with Febris Uveo-Parotidea Subchronica, Klin. Monatsbl. f. Augenh. **52**:281, 1914.

Souter, W. C.: Uveo-Parotid Fever with Autopsy Findings, Tr. Ophth. Soc. U. Kingdom **49**:113, 1929.

Tait, C. B. V.: Uveo-Parotitis, Lancet **2**:748 (Oct. 6) 1934.

Thomsen, H.: Case of Uveoparotid Fever Treated with Tuberculin, Ugesk. f. læger **81**:1517, 1919.

Weve, H.: Etiology of Uveo-Parotid Fever, Am. J. Ophth. **1**:433, 1918.

Familiäre pseudotuberkulöse symmetrische Entzündung der Speichel- und Tränen-Drüsen und der Uvea (Mikulicz-Heerfordt), Ztschr. f. Augenh. **60**:68, 1926.

Ueber Febris uveo-parotidea, Klin. Monatsbl. f. Augenh. **78**:83, 1927.

Correspondence

A NEW THEORY OF BINOCULAR VISION

To the Editor:—Dr. F. H. Verhoeff, in his article entitled "A New Theory of Binocular Vision," in the February 1935 issue of the ARCHIVES (vol. 13, p. 151), made the following statement: "The fact that perception of depth may still occur when disparate images are seen as two and no movement and rivalry are perceptible disproves the theory recently advanced by Washburn." The reference is to my article, "Retinal Rivalry as a Neglected Factor in Stereoscopic Vision," in the *Proceedings of the National Academy of Sciences* (**19**: 773, 1933). Dr. Verhoeff evidently read it as, "Retinal Rivalry as the Cause of Stereoscopic Vision." There are, of course, several factors, any one of which acting alone or with others will produce the impression of solidity or depth.

MARGARET F. WASHBURN,
Vassar College, Poughkeepsie, N. Y.

To the Editor:—Professor Washburn stated that I read her article entitled "Retinal Rivalry as a Neglected Factor in Stereoscopic Vision" as "Retinal Rivalry as the Cause of Stereoscopic Vision." I have reread her article, and I feel that I was justified in this interpretation of it. She quoted Donders as saying: "In general we cannot tell with which eye we receive a visual impression." She then stated: "But the slide on each side of which there is a combination of the right eye's view of an object and the left eye's view looks flat when seen through the stereoscope. It follows that the stereoscopic perception of solidity is not derived from a retinal pattern composed of two images of an object obtained from different points of view. What then is the nature of the stereoscopic factor?" This indicates that she had in mind that, at least as concerns disparate images, there was only one factor to be considered in stereoscopic perception of solidity. She brought forward the view, with observations to support it, that this factor was retinal rivalry, yet she said, "If a slide carries a vertical line on one side and a horizontal line on the other, when it is looked at through the stereoscope a cross appears which is indistinguishable from the one that would appear if a cross were drawn on both sides." This statement is not true, as was shown by Helmholtz, but if it were true it denies the existence of rivalry and hence the whole basis of Professor Washburn's paper.

It is evident from the use of the term "apparent movement" that Professor Washburn assumed that the stereoscopic factor must be consciously recognizable, and since one does not consciously know with which eye one is seeing, disparateness per se cannot be the factor in stereoscopic vision. In my article to which she refers, I pointed out that one does not consciously recognize the factors on which one's judg-

ment of stereoscopic depth is dependent, but consciously perceives only the result of these factors. I mentioned that in the occipital lobe disparate images are represented separately, so that here there is evidence on which judgment of depth may be made. In normal stereoscopic vision only one disparate image is seen, although not necessarily always the same one, for it is only exceptionally that one perceives physiologic diplopia.

Professor Washburn has stated that under some conditions disparate images may alternately disappear, a fact evident to any one who has observed the two images of a finger on looking at a distant heteronymous background. She has also pointed out that apparent movement of disparate images may occur under special conditions, such as existed in her experiments. But she has brought forward no evidence that either of these phenomena is concerned in the perception of depth. The apparent movement on which she relies can give no information to consciousness as to whether an object is in front of or behind another unless consciousness knows to which eye each disparate image belongs, and Professor Washburn's premise is that consciousness does not possess this knowledge. I am not so bold as to say that retinal rivalry, or anything else which could produce differences in the brain, could not be of some significance in the perception of depth. As a matter of fact, however, I have found by means of experiments on binocular flicker that apparent shifting of disparate images interferes with rather than aids the perception of depth.

F. H. VERHOEFF, M.D.,
Howe Laboratory of Ophthalmology, Boston.

To the Editor.—Dr. Verhoeff infers that I put forward retinal rivalry as the *sole* factor in stereoscopic vision because of the fact that a pattern composed of the right eye's view of a solid object superimposed on the left eye's view looks flat; this fact indeed shows that the fusion of the two retinal images is not the cause of the stereoscopic factor. But it does not mean that if the factor of linear perspective or that of aerial perspective were present the perception of depth might not result. Retinal rivalry is one factor but not the only factor.

He remarks on my statement that "if a slide carries a vertical line on one side and a horizontal line on the other, when it is looked at through the stereoscope a cross appears which is indistinguishable from the one that would appear if a cross were drawn on both sides," first, that the statement is not true, "as was shown by Helmholtz." I refer to Helmholtz' statement on page 893 of the 1896 edition of the Physiologische Optik: "Wir für gewöhnlich kein gestimmter Bewusstsein haben mit welcher Auge wir das eine oder andere Bild sehen.

Secondly, Dr. Verhoeff remarks that if the statement were true it would deny the existence of rivalry. To this it may be answered that rivalry occurs only between incompatible images. When, as in the case of the left eye's image and the right eye's image of a solid object, incompatible movements are suggested, touch associations cannot reconcile them and they must alternate in consciousness.

MARGARET F. WASHBURN.

News and Notes

SOCIETY NEWS

Association for Research in Ophthalmology.—The seventh scientific meeting of the Association for Research in Ophthalmology was held on May 12 at Kansas City, Mo. The following papers were presented:

1. "Goniotomy or Incision of Schlemm's Canal for Chronic Glaucoma; Results of Gonioscopic Research." Dr. Otto Barkan, San Francisco.

2. "Studies of the Action of Staphylococcus Toxin and Antitoxin with Special Reference to Ophthalmology." Dr. Earl L. Burky, the Johns Hopkins Hospital, Baltimore.

3. "Precipitins in the Ocular Tissues of Rabbits Generally and Locally Immunized with Crystalline Egg Albumen: Their Relationship to Allergy." Dr. Richard Thompson, Dr. Eduardo Gallardo and Dr. Deborah Khorazo, College of Physicians and Surgeons, Columbia University, New York.

4. "An Investigation of the Angular Relation of the Visual and Optic Axes." Dr. George E. Park, Department of Ophthalmology, Northwestern University, Chicago.

5. "On the Nature of the Ocular Fluids." Dr. Karl Meyer and John W. Palmer, Ph.D., College of Physicians and Surgeons, Columbia University, New York.

6. "Observations on the Reducing Substances (Glucose) of the Aqueous and Vitreous Humors of the Eye." Dr. William M. James and A. J. Seifker, Ph.D., Washington University, St. Louis.

7. "Roentgen Ray Cataract—an Experimental, Histologic, and Clinical Study." Dr. P. J. Leinfelder and Dr. H. D. Kerr, the State University of Iowa, Iowa City.

8. "Iritis Produced in Rabbits' Eyes by the Intravenous Injection of Crude and Purified Cultures of Bacteria Isolated from Patients with Certain Inflammatory Eye Diseases—Preliminary Report." Dr. Conrad Berens, Edith L. Nilson and George H. Chapman, New York.

National Society for the Prevention of Blindness.—Announcement has been made by the National Society for the Prevention of Blindness that courses for the training of teachers and supervisors of sight-saving classes will be offered at the 1936 summer sessions of the following schools:

The University of Cincinnati, Cincinnati, June 22 to July 28.
The University of California at Los Angeles, West Los Angeles, Calif., June 27 to August 7.

State Normal School, Oswego, N. Y., June 29 to August 7 (the course will be given in Syracuse).

Teachers College, Columbia University, New York, July 7 to August 14.

Further information regarding the courses may be obtained from the university or college.

International Association for the Prevention of Blindness.—On May 11 the General Assembly of the International Association for the Prevention of Blindness and the International Organization of the Campaign Against Trachoma was held in the Grand Amphitheatre of the Centre Marcelin Berthelot, 28 bis, rue St. Dominique, Paris. Reports on "Infectious Conjunctivitis in Children Under Ten Years of Age" were presented and discussed.

Philadelphia County Medical Society, Eye Section.—The following program was presented at the scientific meeting of the Eye Section of the Philadelphia County Medical Society, held on May 7:

Motion picture, Dr. Samuel Horton Brown; "Nation-Wide Action on a Nation-Wide Problem," Lewis H. Carris, managing director of the National Society for the Prevention of Blindness; "Industrial Vision and Its Preservation," Dr. H. Maxwell Langdon; "Cosmetics Detrimental to Vision," Dr. Walter I. Lillie; "Glaucoma and Its Relation to the Conservation of Vision," Dr. Edwin B. Miller.

Ophthalmological Society of the United Kingdom.—The subject of phlyctenular keratitis was discussed by Mr. Arnold Sorsby, Dr. R. Hamburger and Miss L. R. Benham at the annual congress of the Ophthalmological Society of the United Kingdom, London, held at the Royal Society of Medicine from April 2 to 4.

Special interest attaches to phlyctenular ophthalmia, not only because of the great suffering that it causes in children but also because of the amount of permanent visual defect arising from corneal scarring. Moreover, it has general implications, for tuberculosis has frequently been imputed as a cause of the disease. The work carried on at White Oak Hospital, Swanley, with its unique clinical material, has confirmed the findings of other observers that about 80 per cent of patients with phlyctenular keratitis show a positive Mantoux reaction, this still being the case when only children under the age of 6 are considered. Moreover, roentgen examination of the chest in a series of 116 cases of phlyctenular keratitis revealed tuberculous lesions, some of them probably active, in no less than 70.7 per cent of the cases, as against 16.1 per cent in a control series of 87 cases of blepharitis. These findings, too, are parallel to those reported by other observers. One point of interest is the high incidence of tuberculosis found in a series of 238 patients with phlyctenular keratitis admitted to White Oak Hospital from 1924 to 1930. When their after-history was traced, it was found that 14 of them, or 5.9 per cent, subsequently required hospitalization for tuberculosis, giving an incidence approximately ten times as high as the notification rate for tuberculosis for the corresponding age group.

GENERAL NEWS

Aid to the Needy Blind.—The Social Security Board has recently announced an appropriation of $2,000,000 of federal funds for the last five months of the fiscal year ending June 30, 1936, and a sufficient sum has been authorized thereafter to enable each state to give financial assistance to the needy blind. This sum is available to the states the plans of which have been approved by the Social Security Board. Thirty-nine states and the District of Columbia are participating in this federal-state program of assistance, which was inaugurated by the Social Security Act.

The Federal Government gives an amount equivalent to one-half the total sum expended under the State plan with respect to each blind person who is not an inmate of a public institution and who is not receiving old-age assistance. This aid is limited to $15 a month, with an additional 5 per cent to the State for administrative purposes.

Course in Ophthalmology at Northwestern University Medical School.—The course in ophthalmology given in the medical school of Northwestern University will be repeated in 1936-1937, beginning September 1. The duration of the course is nine months, with an additional summer quarter, if desired. Arrangements may be made for full time work in ophthalmology, or half the student's time may be spent in the study of some other subject, such as otolaryngology. Registration is limited to eight physicians. Further particulars may be obtained from Dr. J. R. Miller, Assistant Dean, 303 East Chicago Avenue, Chicago.

Leslie Dana Gold Medal to Dr. John M. Wheeler.—The Leslie Dana Gold Medal for "outstanding achievements in the prevention of blindness and the conservation of vision" was presented on May 9 to Dr. John M. Wheeler, professor of ophthalmology in the medical school of Columbia University and director of the Eye Institute at the Columbia University-Presbyterian Hospital Medical Center in New York. Dr. Wheeler was selected by the National Society for the Prevention of Blindness in cooperation with the St. Louis Society for the Blind, which offers this highly prized mark of recognition annually.

Obituaries

WILLIAM HOLLAND WILMER, M.D.
1863-1936

William Holland Wilmer, son of the Right Reverend Richard Hooker Wilmer, Protestant Episcopal Bishop of Alabama, and Margaret Brown Wilmer, was born on Aug. 26, 1863, in Powhatan County, Va.

He received his early education at the Episcopal High School near Alexandria, Va., and entered the University of Virginia. After a course in the academic and medical departments, he graduated in 1885 with the degree of Doctor of Medicine. The following fall he passed a competitive examination and was admitted to the Mount Sinai Hospital, in New York. It was here that he met Dr. Emil Gruening, ophthalmic surgeon of the hospital, who interested him in the specialty of ophthalmology. On completing his internship, he studied in various European clinics and later returned to New York, where he became associated with Dr. Gruening in his private practice. At the same time he was appointed lecturer on diseases of the eye at the New York Polyclinic Medical School and Hospital, carrying on his clinical work in the outpatient department of the Bellevue Hospital.

Dr. Wilmer had always cherished the hope that he would eventually live in Washington, D. C. To this end he worked while in New York, and in 1889 he established his office in the capitol city.

A charming personality, a thorough clinical knowledge of his specialty and his recognized professional skill were factors in the early establishment of a large and influential following, staunch friends as well as patients, which as the years passed soon placed him in the front rank of the nation's most prominent oculists.

In 1891 he married Miss Re Lewis Smith, daughter of James M. Smith and Rebecca Gibbons, of Pennsylvania.

Appreciating the need of a special hospital in Washington for the treatment of diseases of the eyes, Dr. Wilmer and five of his confrères in 1897 founded the Episcopal Hospital, under the auspices of the Episcopal Church. He was a member of its staff until 1925, after which he remained as consultant.

In 1906 the Georgetown University elected him to the chair of ophthalmology, a position he held until 1925, when he resigned to take up his work in Baltimore. In 1911 he was commissioned a lieutenant in the medical reserve corps of the United States Army. When this country entered the World War he was called into the service and was sent

as officer in charge of the medical research laboratory of the air service at Minneola, L. I. Later he was ordered to France, serving with the American Expeditionary Forces with the rank of colonel as surgeon in charge of medical research laboratories. After being honorably discharged in 1919, he was promoted to the rank of brigadier general in the medical reserve corps. Several years later the United States government recognized his splendid war service by awarding him the Distinguished Service Medal. The French government decorated him with the cross of a commander of the Legion of Honor.

After his discharge from the army he returned to Washington, where he resumed his private practice. It was in 1922 that a group of friends and his most grateful patients founded the William Holland Wilmer Foundation, which, in cooperation with the Rockefeller Foundation, the Commonwealth Fund and the Johns Hopkins University, raised a fund of approximately $4,000,000 for the erection and endowment of the Wilmer Institute of Ophthalmology.

In 1925 Dr. Wilmer moved to Baltimore, taking up his duties as professor of ophthalmology of the Johns Hopkins University and ophthalmologist in chief of the Johns Hopkins Hospital. At the same time he labored incessantly over the erection and equipment of the institute and the organization of his scientific staff. The completed institute was opened to the public in the fall of 1929 as a unit of the Johns Hopkins University, with Dr. Wilmer as its director.

In the summer of 1934, on reaching the age of retirement, Dr. Wilmer returned to Washington to resume private practice. He was a member and past president of the American Ophthalmological Society, the Association of Military Surgeons of the United States and the Medical Air Service Association; a member of the board of directors of the Advisory Committee for the Prevention of Hereditary Blindness, and a member of the National Institute of Social Science, the National Committee on Mental Hygiene, the American Association for the Advancement of Science and the Washington Academy of Sciences. He was an honorary member of the Oxford Ophthalmological Congress, of England, the Hungarian Ophthalmological Society, the Chicago Ophthalmological Society and the Saranac Medical Society. Princeton, Johns Hopkins, New York and Georgetown universities conferred honorary degrees on him, the latter awarding him the Decoration of Angelo Secchi.

While Dr. Wilmer was not a prolific writer, he frequently contributed to the various ophthalmologic journals of this country and abroad, and special mention should be made of two of his most valuable contributions, namely, "Aviation Medicine in the A. E. F." and "Atlas Fundus Oculi," which is truly a real contribution to ophthalmology based on personal observation, one of the most valuable methods of instruction.

The introductory chapter written by the author is most illuminating and happily free from the usual confusing terms used in the old ocular nomenclature. The exquisite paintings of the fundus of the eye have been marvelously reproduced in colors as near to the natural as is

WILLIAM HOLLAND WILMER
1863-1936

humanly possible. Dr. Wilmer was always at his best with the ophthalmoscope, and it is here that the value of the work is manifest. His descriptions of the pictures of the fundus are written in that particularly careful concise manner which his genius for details had long instilled in

him. The work will always be of great benefit to both the ophthalmologist and the clinician and of inestimable value in teaching.

Dr. Wilmer died "in the harness." On the morning of March 12, 1936, as he was preparing to attend his office, he felt ill, and shortly after the end came quietly and peacefully. He is survived by his widow, two sons, Richard Hooker Wilmer and William Holland Wilmer Jr., and a daughter, Mrs. Russell E. Sard, besides several grandchildren.

It was my privilege to have known Dr. Wilmer for over two score years, and from 1897 to 1915 I was intimately associated with him professionally. He was modest, courteous and, above all, thoughtful of others, and his charm and personality drew one to him from the very beginning. The meticulous study and patient investigation which he gave to every patient who came under his care were never abridged by any consideration of time or personal convenience. No sign or symptom was too vague but that he satisfied himself as to its cause or significance before delivering his opinion. He cared nothing for material gain. It was the patient's need, not his wealth or prestige, which interested him. Whenever the smallness of his fees was mentioned, invariably his answer was, "I prefer to keep them so for it permits those I wish most to help to consult me." He was a most charitable man, giving of his time and strength freely, without thought of remuneration, to those who sought the benefit of his professional skill. Dr. Wilmer was a diagnostician of great ability and as an operator was cool and confident, always keeping well abreast of the newer surgical methods and winning the confidence of his patients by his manner and technic.

In his relations with his associates he was always honorable, kind and considerate, expecting them to give to their work the same painstaking care and study which he himself gave. Those who were fortunate enough to know him in his home saw in him a most charming host and an ideal husband and father. Dr. Wilmer spent little time in recreation, golf being his only hobby until later in life, when he became interested in horticulture, attested to by the many rare and beautiful specimens found on his country place in Clark County, Va.

Descendant of a long line of illustrious Episcopal prelates, he was a convinced believer in the essential doctrines of his church, unfalteringly practicing them in his daily life. He was a trustee of the National Cathedral from 1915 to the day of his death, and his body now rests in the crypt of the Chapel of Joseph of Aramathea in the Cathedral of Sts. Peter and Paul, which he loved and served so well.

LOUIS S. GREENE, M.D.

In the fall of 1925 Dr. Wilmer came to Baltimore to organize the Wilmer Ophthalmological Institute as an integral part of the Johns

Hopkins Hospital and to organize in the Johns Hopkins University School of Medicine the first full time department of ophthalmology in this country.

At that time Dr. Wilmer was 61 years of age and was probably the most widely known and successful practitioner of his specialty in America, if not in the world. His extraordinary reputation was built on a firm foundation of sterling qualities. He was a diagnostician of remarkable ability, a surgeon of unusual skill and a specialist who fully appreciated the close relationship of his specialty to general systemic disease. To these high professional attainments, he added a clear and deep comprehension of the psychology of patients with diseases of the eye, the highest moral and professional character and a truly great personal magnetism. Moreover, he was a man of charming simplicity and gentleness. His life's work up to that time had been chiefly of a clinical nature. While his teaching duties had not been heavy, his ability as a teacher had found ample expression in the caliber of the men he had trained. Probably his major experience in administrative work had been his eminently successful war service as surgeon in charge of the medical research laboratory of the air service at Issudon, France. These were the assets and equipment he brought with him in undertaking the supreme task of his life.

He personally undertook the full organization of the Wilmer Institute, and its success or failure was his direct responsibility. The full credit for its success, therefore, belongs to him and not to his associates or advisers. He approached his task by making a preliminary survey of the most prominent ophthalmic institutes both in this country and abroad, and so developed a general idea of the type of institute he desired finally to establish. He began, however, in a small way. One of the older buildings of the Johns Hopkins Hospital was remodeled as a pavilion for the treatment and study of ocular diseases. He then proceeded with his plans for the final institute. This he designed on a broad scale, with various subdepartments dealing with the different phases of the science of ophthalmology. To expect that all these subdepartments would survive as necessary and successful units in the final institute is to expect too much. That the majority of them have stood the test of eleven years' scrutiny and criticism is in itself a testimonial to the farsightedness and wisdom of the founder.

From the beginning he conceived his first duty to be the establishment of the institute on a sound clinical basis, and to this end he rigorously trained his first small staff—ultimately to become the nucleus of the completed institute—in the refinements of diagnosis and the niceties of technic. He seemed tireless in his application to his work. The days were never too short or the hours of toil too long for him to give unlimited time to the discussion of the problems before him, the build-

ing and organization of the institute. Constantly he sought advice. He not only was open to suggestions but welcomed them. His decisions were not made hastily.

When the institute was finally completed and in full operation, he did not rest from his labors but remained indefatigable in his activities. He retained and personally directed a large portion of his consulting practice. He examined and operated on large numbers of patients in the public wards. He was faithful and punctilious in the discharge of his teaching assignments. He was constantly and readily available to all the members of his staff, to discuss with them their clinical, scientific and personal problems with keen interest and to give wise advice. To his staff he was affectionately known as "the chief." He was a strict disciplinarian, expecting and receiving full and sound service, but his rule was always a kindly one, full of sympathetic understanding, tempered by a real affection for those with whom he worked, and this affection was returned in full measure. He asked less of his staff and his associates than he was prepared to give himself.

Beyond the debt owed him by the science of ophthalmology, the Johns Hopkins University and the Johns Hopkins Hospital owe him a debt for the wholehearted interest and devotion with which he dedicated himself to the task of organization of the Wilmer Institute and for the establishment of the institute on a sound scientific and clinical basis. His colleagues in the university owe him a debt for his wise counsel and stimulating friendship. His associates in the Wilmer Institute and the men he trained owe him a boundless debt for his kindly and endless patience and sympathy, for his ceaseless efforts that every opportunity and facility might be theirs, for his physical sacrifice of himself in organizing the institute that they might carry on, and, finally, for his splendid example as a physician, a gentleman and a leader.

ALAN C. WOODS, M.D.

William Holland Wilmer was a sterling man. In his death the medical profession, and especially that branch to which he devoted his chief endeavors, have suffered a grievous loss. He worked well and hard, and the success these activities achieved gave him the distinguished reputation which he rightfully enjoyed.

Patients seeking his advice trustfully turned to him because they knew they would receive not only the benefits of professional skill but also an understanding sympathy for their trouble.

This interesting blend of professional skill and understanding sympathy which Dr. Wilmer so finely portrayed was the foundation of his notable success, as has been the case with others who happily possess similar professional attributes.

He was thorough in all his varied professional relations. His case histories were excellent, and the perusal of them gave the reader a clear insight into the patient's condition.

His organization of an ophthalmologic institute to be associated with the Johns Hopkins Hospital, very properly named the Wilmer Ophthalmological Institute, was a splendid piece of work, the first full time department of ophthalmology to be established in the United States.

When the World War came Wilmer naturally entered the military service, and for his work in the army, detailed by Dr. Greene and Dr. Woods, he was awarded the Distinguished Service Medal. Of the many activities with which he was concerned at that time, those which pertained to aviation and the standards which were established from the visual standpoint were most important, especially in determining the ocular conditions of those who hoped to join the aviation corps and in establishing a definite standard for admission.

Overwork abroad caused an illness which required a cessation of his activities but which passed away without permanent effects owing to the care he received at the hands of an accomplished assistant.

When the war was over, Wilmer returned to his practice and civilian duties with an efficiency that has always characterized his work.

His publications, which were not numerous, were the product of careful observation and study, and to one of these publications special attention must be drawn, namely, his "Atlas Fundus Oculi;" all the illustrations are from cases in his own practice all of which were studied with infinite care. These beautiful plates and their descriptions are a permanent and highly valuable addition to the literature of ophthalmology, of which Wilmer may well have been proud.

Dr. Wilmer maintained with great care the important relations between general medicine and ophthalmology, and that is one of many reasons that a patient who came for consultation, observation or treatment obtained such satisfactory results.

He fulfilled the various obligations which are concerned with the examination of a patient firmly but also kindly, and whether from the operative or from the medicinal standpoint he rarely failed to satisfy his patient.

He was an excellent speaker, and at medical meetings, either in discussion or in the presenting of an original communication, he commanded close attention. His experience had been large, and his listeners desired to hear what it had taught him.

Few men have so successfully fulfilled the obligations of professional life. She who knew and loved him best was a great help in the manifold duties of his active life, and their cooperative work stimulated very real admiration. Wilmer has left us, alas! He will be missed as few men are.

G. E. DE SCHWEINITZ, M.D.

Abstracts from Current Literature

EDITED BY DR. WILLIAM ZENTMAYER

Anatomy and Embryology

INVESTIGATION OF THE MUSCULATURE OF THE LACRIMAL PASSAGES. D. CATTANEO, Ann. di ottal. e clin. ocul. **63:** 801 (Nov.) 1935.

Cattaneo made serial sections of the tissue in the region of the canaliculi and lacrimal sac in eleven cadavers. To give complete orientation, sections were made in the frontal, sagittal and horizontal planes. The muscle fibers which surround the canaliculus form the so-called Duverney-Horner lacrimal muscle. They are inserted posteriorly on the posterior lacrimal crest and on the bony orbital wall behind the crest. They are attached to the posterior wall of the common canaliculus near its opening into the sac, dividing into bundles for the superior and inferior canaliculus. In the horizontal portions of the canaliculi muscle bundles were found not only in the posterior wall but anteriorly, above and below. These fibers form intimate attachments with the layer of elastic tissue surrounding the canaliculi. No trace was found of any arrangement of muscle fibers about the entrance of the canaliculus into the sac in the form of a sphincter such as has been described by some authors, nor of any arrangement of muscle fibers around the lacrimal points. More muscle fibers were present about the inferior than about the superior canaliculus. Anterior to the lacrimal sac and the medial portions of the common canaliculus muscle fibers were found which were entirely separate from the posterior Duverney-Horner lacrimal muscle. Cattaneo could not determine whether these fibers form a separate anterior lacrimal muscle or are to be considered as a part of the orbicularis muscle.

A bibliography and photomicrographs accompany the article.

S. R. GIFFORD.

Bacteriology and Serology

THE DIAGNOSIS OF DORMANT OCULAR TUBERCULOSIS BY MEANS OF THE AGGLUTINATION REACTION OF HOLLANDE. C. DEJEAN and CAMBOULIVES, Arch. d'opht. **52:** 258 (April) 1935.

The technic of this laboratory test is described and its sensitiveness compared with that of other serologic tests. Its application in sixteen cases (ten of chronic choroiditis and high myopia, two of uveitis and three of recurrent hemorrhages of the central retinal vein) is described. In this group the Hollande test was positive eleven and negative five times. In this same group the Besredka and Vernes tests were positive twice, each in different instances. In these four instances the Hollande test was also positive. Only once did a doubtful Besredka coincide with

a negative Hollande reaction. Of the eleven patients with a positive Hollande reaction, six were found to have clinically latent tuberculosis. Dejean and Camboulives believe that this test is of great value in obscure cases and that it opens up the possibility of a treatment which sometimes proves of great benefit.

S. B. MARLOW.

ALLERGY OF THE EYE. J. BISTIS, Arch. d'opht. **52:** 794 (Nov.) 1935.

Atropine, pilocarpine and some preparations of mercury have long been known to produce conjunctivitis after prolonged use. The probability that the conjunctivitis is allergic is discussed. Bistis cites a case in which conjunctivitis was evidently caused by zinc sulfate and a second case in which conjunctivitis was probably due to yellow mercuric oxide.

S. B. MARLOW.

CONSIDERATIONS OF ONE HUNDRED AND THIRTY STRAINS OF PYOGENIC STAPHYLOCOCCI ISOLATED FROM CHRONIC CONJUNCTIVAL LESIONS. CARLOS S. DANIEL and C. RECHNIEWSKI, Arch. de oftal. de Buenos Aires **10:** 637 (Aug.) 1935.

This is a study of the biologic conditions of 130 strains of Staphylococcus pyogenes isolated in 140 cultures from conjunctival secretions. All were gram-positive and had the grapelike arrangement. Eighty-nine strains coagulated milk within forty-eight hours, and 15, somewhat later. Lactose broth was strongly acidified without production of gas in 109 cases; there was a negative reaction in 20 cases and a doubtful reaction in 1. The action on dextrose was positive in 120 cases, negative in 7 and doubtful in 3. Gelatin was liquefied in 104 cases; the reaction was negative in 24 and doubtful in 2. The chromogenic action on potatoes of 106 strains considered pathogenic gave gold pigment in 20 cases, yellow in 37 and white in 49.

Staphylococci can be divided into saprophytic and pathogenic strains. The authors have considered as belonging in the latter class those coagulating milk, fermenting lactose and liquefying gelatin, 106 of the 130 strains showing these characteristics.

The pus from which these strains were isolated came mostly from chronic conjunctival secretions, not always marked.

C. E. FINLAY.

Biochemistry

APPLICATION OF MICROQUINHYDRONE ELECTRODE TO DETERMINATION OF p_H OF AQUEOUS HUMOR OF RACHITIC AND NORMAL RATS. J. A. PIERCE, J. Biol. Chem. **111:** 501 (Oct.) 1935.

The average p_H of the aqueous in thirty-four rachitic rats was 7.38; that of the aqueous in eighteen normal rats, 7.46. This supports the findings of previous workers as to the tendency toward acidosis in rickets.

J. E. LEBENSOHN.

PHYSICOCHEMICAL STUDIES ON THE NORMAL AND THE PATHOLOGIC LENS. J. NORDMANN, Arch. d'opht. **52:** 78 (Feb.); 170 (March) 1935.

In this article Nordmann reviews the whole subject of the physical chemistry of the lens in health and in disease and presents the results of experiments and observations made by himself. He first offers a brief historical review and follows with a more detailed account of the characteristics of the normal and of the cataractous lens as reported by others. He devotes the bulk of the paper to a detailed account of his own studies, which are correlated and discussed with reference to the literature. His conclusions are: 1. The depression of the freezing point (cryoscopic point) for the normal lens averages —0.55 degree (extreme limits, from —0.51 to —0.63); that of the cataractous lens averages —0.54 degree (limits from —0.5 to —0.61). 2. The p_H of the normal lens averages 7.4 (from 7 to 7.85); that of spontaneous cataract, 7.3 (from 6.8 to 7.7), and that of naphthalene cataract, 7.8 (from 8 to 9.5). 3. The curves of neutralization of normal lenses show some values between p_H 4 and 5 as well as between p_H 8 and 9.5. The curves for opaque lenses are not different from the normal. 4. The cataphoresis of the normal lens very often has an iso-electric point in the region of p_H 6. In cataract this point is higher but approaches the p_H of the normal lens. 5. The platinum potential and the equilibrium of oxidation reduction of the normal lens is at +87 millivolts (from +50 to + 120 millivolts). It corresponds to a p_H of 7.4, an r_H of 17.8. The corresponding figures for cataract are + 166 millivolts (from + 144 to 176 millivolts), which corresponds to a p_H of 7.3, an r_H of 20.3. 6. The power to inhibit the oxidation reduction is important in the normal lens and is a plateau lying between + 165 and + 120 millivolts. This plateau persists in naphthalene cataract. It is abolished or at least altered in human senile cataract. 7. The minimum swelling of the lens placed in solutions of varying p_H is found at p_H 6. The swelling is in close relationship to the p_H and the Δ of the normal lens. It diminishes markedly in solutions of cresyl blue having an r_H close to that of the normal lens. 8. The development of cataract is characterized by a series of phenomena related to oxidation reduction. At the same time there is a splitting of the proteins with a displacement of the p_Hi (and in spontaneous cataract, perhaps also of the p_H). S. B. MARLOW.

Conjunctiva

INCLUSION BLENNORRHEA. S. H. MCKEE, Am. J. Ophth. **18:** 36 (Jan.) 1935.

McKee discusses epithelial cell inclusions and describes inclusion blennorrhea as a "new disease" occurring in infants and resembling gonoblennorrhea. The prognosis, however, is good. He examined twenty-seven new-born infants with ophthalmia and found epithelial cell inclusions in seventeen cases. In eight of these cases they were combined with gonococci and in one case with streptococci. He found gonococci alone in five of the seventeen cases and streptococci or pneumococci alone in five cases. He discusses the inclusion bodies found in trachoma, inclusion blennorrhea and swimming pool conjunctivitis.

He concludes with Stewart that the inclusion is formed by phagocytosis of bacteria which are not the cause of these diseases but which carry the viruses.

W. S. REESE.

TEMPERATURE CHANGES IN THE CONJUNCTIVA IN RELATION TO APPLICATION OF HEAT AND COLD TO THE SKIN. G. H. GOWEN, Am. J. Ophth. **18:** 331 (April) 1935.

From his experiments on dogs Gowen drew the following conclusions:

"1. Chilling of the skin results in a reflex lowering of the temperature of the conjunctiva.

"2. This response is markedly exaggerated after repeated applications of cold.

"3. Chilling of the skin with the associated lowering of the temperature of the conjunctiva should predispose to conjunctivitis.

"4. The conjunctiva responds to chilling of the skin in the same manner as does the upper respiratory tract.

"5. The similarity of the reflex response of the conjunctiva and of the mucous membrane of the nose to chilling of the skin may explain the simultaneous involvement of conjunctiva and nose in acute coryza."

W. S. REESE.

LIGNEOUS CONJUNCTIVITIS. R. CASTROVIEJO, Arch. de oftal. hispanoam. **35:** 634 (Dec.) 1935.

Castroviejo reports a case of a conjunctival disease and refers to three other cases observed by Borel, reports of which have not been published. He found only six cases described in the literature.

The objective features were similar to those of diphtheritic conjunctivitis but with a chronic course: conjunctivitis with scant secretion, a false membrane adherent to the tarsal conjunctiva and an induration of cartilaginous consistence on the bulbar conjunctiva. The latter persisted for months, with secondary lesions appearing finally in the cornea. No improvement was obtained, notwithstanding excision and cauterization, which temporarily exacerbated the symptoms, as in other cases reported. A biopsy revealed no neoplasm—only inflammatory lesions—and examination of the conjunctival secretion and inoculations gave no evidence of the presence of the diphtheria bacillus or of any other etiologic agent.

The author coincides with other reporters in confessing complete ignorance as to the cause of this obscure process, the nature of the inflammation and the therapeutic indications.

C. E. FINLAY.

Cornea and Sclera

THE INNERVATION OF THE CORNEA. KARL REISER, Arch. f. Augenh. **109:** 251, 1935.

Reiser reviews the literature on the histologic structure of the corneal nerves and gives a description of the arrangement of the nerves as he interprets them. No new technic is given.

F. H. ADLER.

FAMILIAL LATTICE-SHAPED DEGENERATION OF THE CORNEA. L. NÉMETH, Klin. Monatsbl. f. Augenh. **95:** 73 (July) 1935.

Németh observed lattice-shaped degeneration of the cornea in a man aged 46 and in his sister aged 33 as well as in his two children, a girl aged 6 and a boy aged 5. The patient's father suffered from this affliction; other members of the family could not be reached. The man stated that his eyes had become periodically inflamed for a week every two years since a time during the war when he contracted a cold. The inflammation usually set in with pain in the eyes and was followed by coryza. In the reflected light of the slit lamp the cornea resembled scratched glass. The scratches were independent of the course of the corneal nerves. Macular and dotlike opacities were observed in various depths of the substantia propria. The epithelium assumed a spotted green staining with fluorescein, and its surface was pitted. There were remnants of previous iritides. The man's sister presented a similar appearance of the corneas, but rather in the initial stage; inflammatory changes were absent. Both adult patients had hyperopic astigmatism of a high degree, and this condition was noted also in the two children. In and directly beneath Bowman's membrane in the children's corneas, especially in its center, minute grayish-white dots were seen with the slit lamp, but not with focal illumination. Both children suffered from recurring corneal abrasions.

The inflammatory attacks led to an increase of the corneal opacities in the two adults. The inflammation was brought on, in Németh's opinion, by a chemical reaction of the degenerative portions of the cornea or through the influence of foreign substances which were deposited and which caused the opacities. Slight degenerative processes of this type in the cornea, which frequently remain unnoticed, may cause no inflammation. More extensive degeneration and deposition of foreign substances, however, cause the reaction which produces the inflammatory attacks.

K. L. STOLL.

THERAPY-RESISTANT SYPHILIS, ESPECIALLY PARENCHYMATOUS KERATITIS, AND ITS TREATMENT WITH QUININE. J. SCHERESCHEWSKY, Klin. Wchnschr. **14:** 381 (March 16) 1935.

In 1909 Schereschewsky reported before the International Congress of Ophthalmology in Budapest his experimental work with quinine in the treatment of syphilis in apes. For the past ten years patients with syphilis have been under treatment with quinine by mouth and have remained symptom-free. Three of these patients had a second infection. Vernes reported excellent results from the use of quinine in experimental syphilis with keratitis in rabbits. Three cases of hereditary syphilis with interstitial keratitis are reported in detail. The first patient, a girl of 8 years, had most of the signs of congenital syphilis together with keratitis so severe that the irides were totally obscured. Quinine chloride (0.25 Gm.) was given six times a day, and after twenty-four hours the corneas were practically healed. The patient also noted a general feeling of well-being. Two other patients, aged 16 and 20 years, were given 8 tablets of quinine chloride per day for four days and showed complete recovery from their keratitis. These patients

received in addition 0.3 Gm. of neoarsphenamine. A 40 per cent quinine ointment used locally in the eyes of one who had a recurrence healed the keratitis in two weeks, with return of normal vision and entire loss of photophobia. Schereschewsky believes that quinine is indicated in treatment-resistant syphilis, especially when the disease is associated with parenchymatous keratitis.

L. L. MAYER.

ETIOLOGY AND THERAPY OF INFECTIOUS CORNEAL ULCERS. H. SCHMELZER, München. med. Wchnschr. **82:** 1906 (Nov. 29) 1935.

In 114 cases of typical corneal serpiginous ulcers the inciting organisms were as follows: Pneumococcus in 60 per cent, with group X in the majority, seldom type III or type II; Streptococcus in 20 per cent; diplobacillus in 13 per cent; Staphylococcus aureus in 3 per cent; others, together with negative cultures, in 4 per cent. The relatively harmless green streptococcus and the streptococcus from the mouth played an unsuspected important rôle. As far as therapy is concerned, the differentiation between Pneumococcus and Streptococcus is of great importance. A gram-positive organism with a capsule is, as a rule, Pneumococcus; without a capsule, it is usually Streptococcus but may be Pneumococcus or Staphylococcus aureus. The serpiginous ulcer should not be cauterized early to permit less scar formation. Optochin, preparations of zinc and tincture of iodine are the medicaments of choice. Electrocoagulation brings the best results in long-standing ulcers. Therapy in support of the general health must be considered in addition to the local therapy. Two charts showing the types of organisms and the degrees of severity in these cases accompany the article.

L. L. MAYER.

Experimental Pathology

EXPERIMENTAL DETACHMENT OF THE RETINA. R. CASTROVIEJO, Am. J. Ophth. **17:** 1112 (Dec.) 1934.

Castroviejo reviews the literature and describes his method. It consists in making a scleral incision and withdrawing from 0.5 to 0.7 cc. of vitreous in a syringe. The retina is then separated from the choroid, and the vitreous is reinjected between the retina and the choroid. A detachment is thus obtained that has all the objective clinical characteristics of a human idiopathic detachment, and it is apparently permanent.

W. S. REESE.

THE MINIMAL QUANTITY OF ULTRAVIOLET AND OF INFRA-RED RAYS WHICH WILL CAUSE DAMAGE TO THE EYE. F. P. FISCHER, D. VERMEULEN and J. G. EYMERS, Arch. f. Augenh. **109:** 462, 1935.

The eyes of rabbits were exposed to light from an arc lamp which was passed through filters of known transmissibility. The wavelengths and the energy of the rays used were carefully measured. The authors chose the first appearance of a change in the reflex photographed from the cornea as an index of minimal damage caused by ultraviolet rays. In the case of infra-red rays the first appearance of the Tyndall effect

in the aqueous was used as an index of minimal damage. Their results correspond well with those obtained by Duke-Elder. They calculate that under normal conditions of employment human beings are never exposed to quantities of ultraviolet or infra-red rays which reach the energy values that were necessary to produce damage in their experiments, but under the conditions of certain employments these values may be reached and the eyes subjected to damage.

F. H. ADLER.

General

OCULAR PATHOLOGY OF THE NEWBORN. W. D. ROWLAND, Am. J. Ophth. **18:** 647 (July) 1935.

Rowland's conclusion is as follows: "A follow-up study of 17 children out of 39 in whom intraocular, extraocular, and head injuries were found at birth in a study of 400 newborn, elicited no residual faults apparently directly attributable to the recorded injuries."

W. S. REESE.

THE RÔLE OF THE VITAMINS IN OPHTHALMOLOGY. H. VIALLEFONT and E. DIACONO, Arch.d'opht. **52:** 723 (Oct.) 1935.

Reference is made at this time only to the known facts concerning vitamins in relation to conditions of the eyes, and to some personal observations. Those conditions recognized as being due to a lack of vitamin A are cited, and their early diagnosis is briefly discussed. Conditions benefited by vitamin A therapy, that is, the chronic forms of keratitis, phlyctenular disease and allied conditions, are referred to, and the case of a syphilitic patient in whom an indolent, refractory ulcer of the cornea healed promptly after local instillation of an oily solution of vitamin A and cod liver oil is reported. Thus there are conditions due definitely to lack of this vitamin, conditions that are benefited by general treatment with the vitamin and conditions that are helped by local treatment with the vitamin. Some reference is made to hypervitaminosis. Vitamin C is discussed in a similar way. Absence or insufficiency of this vitamin is suggested as a possible factor in the causation of recurrent hemorrhages in the vitreous. Its relationship to the development of cataract is reviewed. From a practical point of view the authors believe that ophthalmologists should be aware of the frequency of vitamin deficiency and of the usefulness and efficiency of vitamin therapy, especially of local vitamin therapy, which is harmless and worthy of consideration in daily practice.

S. B. MARLOW.

General Diseases

HISTOPATHOLOGY OF THE EYEGROUND CHANGES IN NIEMANN-PICK LIPOIDOSIS. F. RINTELEN, Arch. f. Augenh. **109:** 332, 1935.

The lipoids, which are ether-soluble and therefore fat-soluble, fall into three groups: phosphatides, cerebrosides and stearines. They are all essential components of living cells, and disturbances in their metabolism lead to certain well recognized disease entities, usually grouped together as the lipoidoses.

Four such diseases are recognized today: 1. A mild form of xanthomatosis, i. e., xanthelasma palpebrarum. This is due to a failure of the excretion of cholesterol so that this alcohol and its esters are deposited in the different tissues, chiefly the skin. Here, as lipochrome, in characteristic cells tumor masses are found, with secondary reactive granulation tissue.

2. Schüller-Christian disease. As a result of the deposition of stearines in the bones and meninges the following symptom complex arises: Through pressure of the xanthomatous nodes on the bones of the skull there develop the characteristic maplike markings and increased intracranial pressure with choked disk. Through pressure on the midbrain and hypophysis there develop diabetes insipidus and dystrophia adiposogenitalis. The growths in the orbit cause exophthalmos. As a rule the disease begins in childhood and runs a chronic course.

3. Gaucher's disease. In this disease one has a deposition of the cerebroside kerasin in the reticulo-endothelial system of the spleen, liver, lymph nodes and spinal cord. There are enlargement of the spleen and anemia with hemorrhagic tendencies. The disease is often familial and has a preference for the Jewish race. Occasionally acute forms are seen, occurring usually in infants, with a predilection for the bones. Idiocy is often present as a result of lipoid degeneration of the cerebral ganglion cells.

4. Niemann-Pick disease. Pick in 1922 differentiated the disease first described by Niemann as phosphatide splenohepatomegaly from Gaucher's disease. In this disease there is a deposition of phosphatides and, to a less extent, cholesterol in nearly all the organs. This is a disease of infants, nearly always of the Jewish race, and affects chiefly females. The liver, spleen and lymph nodes are enlarged. As a result of lipoid degeneration of the ganglion cells in the brain, flaccid and spastic paralyses develop, also progressive idiocy.

In seven of twenty-six patients examined the fundus resembled that in cases of Tay-Sachs disease in having a cherry-red spot in the macula. The analogy between the Niemann-Pick type of lipoidosis and Tay-Sachs disease is so complete in many points that some authors regard Tay-Sachs disease as a localized lipoidosis of the central nervous system (Bielschowsky). This is not accepted by other writers. Schaffer, for example, points out that in Tay-Sachs disease the lipoid infiltration of the mesodermal elements characteristic of Niemann-Pick disease has never been seen.

There are many points of difference between these two diseases, as the present author points out. There is neither splenohepatomegaly nor a characteristic blood picture in Tay-Sachs disease. Familial occurrence is the exception. Further, Epstein was unable to find in Tay-Sachs disease the increase in phosphatides in the brain which occurs in Niemann-Pick disease.

From a study of his cases of Tay-Sachs disease and Niemann-Pick disease Rintelen draws the following conclusions:

1. The grayish-green prominent ring seen around the red fovea in both of these diseases can be explained by the following factors:

(*a*) Edema of the inner granular and inner reticular layers. This edema is caused by the toxic action of chemical products from degen-

erated cells. These cells are most numerous in the macular region, and hence the edema is limited to this region.

(*b*) Lipoid infiltration of the ganglion cells in the macular region.

(*c*) An increase in the glial tissue.

2. The cherry-red spot is caused only by contrast between the normal fovea and the surrounding edematous macula.

3. The macular changes in Niemann-Pick disease can be differentiated from those found in Tay-Sachs disease histologically as follows: In the former disease there is no atrophy of the retinal nerve fibers and optic nerve, nor is there such marked lipoid degeneration of the ganglion cells.

4. The two diseases have sufficient points of difference to warrant keeping them separate as two distinct entities.

5. The cherry-red spot in the macula is not pathognomonic of any one disease entity but will always be found where there is necrosis of the ganglion cells with simultaneous fatty infiltration.

F. H. ADLER.

Glaucoma

TRANSIENT FLUCTUATIONS IN THE SCOTOMA OF GLAUCOMA. J. N. EVANS, Am. J. Ophth. **18:** 333 (April) 1935.

Evans enumerates the variables that had to be considered in a study of the changes in the scotoma of glaucoma in relation to visual acuity and tension. He describes his technic and gives the data on 12 selected cases representing 143 separate studies. He concludes that glaucoma simplex should be regarded as a symptom complex characterized by numerous minor crises which may or may not eventuate in a major crisis, that the pressure curve is accompanied consistently by a curve of graphed areas of scotoma and that fluctuations of central vision probably correspond to these waves. Studies of glaucoma should be made at the earliest practical time in the morning, and coffee should be eliminated from the diet. Since vitamin C is known to maintain the integrity of vascular endothelium, and since glaucoma has a direct relation to decreased integrity of the endothelium, a quart of mixed orange and lemon juice should be given daily.

W. S. REESE.

PHYSICOCHEMICAL CONSTANTS OF THE BLOOD IN GLAUCOMA. E. TROVATI, Ann. di ottal. e clin. ocul. **63:** 641 (Sept.) 1935.

Trovati reports the results of complete examination of the blood in fifteen cases of simple glaucoma. The patients were from 46 to 70 years of age. The sedimentation time and the fragility of the red cells were normal. The coagulation was slightly retarded, while the viscosity was slightly increased. There was a slight elevation of blood pressure in relation to the age. The uric acid content and the blood sugar content were practically normal, the latter being slightly decreased. The blood cholesterol content was high, averaging 0.3 per cent. The ratio of calcium to potassium showed calcium reduced with relation to potassium, and a low alkaline reserve was general, indicating a slight alkalosis. The

last two findings are considered as of possible significance in causing increased tension by producing increased permeability of cell membranes and swelling of the vitreous. The high cholesterol content also seems to indicate a steatosis of the tissues, which may also increase the volume of the vitreous.

S. R. GIFFORD.

THE EFFECT OF DORYL IN THE TREATMENT OF GLAUCOMA. A. MILORO, Ann. di ottal. e clin. ocul. **63:** 780 (Oct.) 1935.

This drug, described in 1932 by Kreitmar, is an ester of choline formed by its union with carbamic acid (carbamolcholine). It possesses marked vagomimetic qualities. It was employed in eleven normal persons and eleven persons with glaucoma, chiefly of the chronic simple type. The concentration of the solution, which was employed by instillation, is not given, but was presumably the 0.75 per cent solution employed by Velhagen in previous investigations of the drug.

In some cases of absolute or almost absolute glaucoma there was no effect on the tension, and the same observation was made in a case of inflammatory glaucoma which did not respond to physostigmine. In most cases of chronic simple glaucoma, however, the effect on the tension was prompt and satisfactory. Miosis was prompt and maximal, lasting usually two and one-half hours following one instillation. There were no local or general disturbances. The tension in normal persons showed usually a fall of from 4 to 6 mm. While the effects of the drug were not superior to those of physostigmine or pilocarpine, Miloro believes there is a place for the drug in the treatment of patients who are intolerant of or sensitized to physostigmine and pilocarpine.

S. R. GIFFORD.

THE PATHOGENESIS OF GLAUCOMA WITHOUT INCREASED PRESSURE. OTTO KURZ, Arch. f. Augenh. **109:** 108, 1935.

Seven cases are reported of glaucomatous cupping and atrophy of the optic nerves with changes in the visual fields, in which there was no rise of intra-ocular pressure above the normal at any time. These cases were excluded from the ordinary run of cases only after the daily tension curve had repeatedly showed no rise of pressure and after the usual tests to bring on an increase in pressure had all proved negative.

Kurz discusses the various theories to account for this found in the literature. Several of the patients showed changes in the sella turcica or calcification in the carotid arteries.

F. H. ADLER.

Hygiene, Sociology, Education and History

LETTERS OF ALBRECHT VON GRAEFE TO F. C. DONDERS (1852 TO 1870). H. J. M. WEVE and G. TEN DOESSCHATE, Klin. Monatsbl. f. Augenh. (supp.) **95:** 1, 1935.

About the time, when the Albrecht von Graefe Medal was given to Hermann von Helmholtz, Donders expressed the wish that some sixty letters addressed to him by von Graefe would be published. Donders

valued these letters so highly that, aside from ordering them deposited after his death at the Graefe Museum of Heidelberg, he had them copied by Baroness E. d'Aulnis de Bourouill. This was no easy task, as Graefe's handwriting was very difficult to read. An attempt to publish these letters was made by Dr. Marianne A. van Herwarden. She died after issuing a short résumé of the content of the letters and an essay on the friendship between the two great men. Weve and Doesschate now fulfil Donders' desire in publishing sixty-seven letters dated between the years 1852 to 1870. Valuable literary and historical comments are appended to each letter, interspersed with notes on Graefe's personality, his life, his health and his death. Many highly interesting topics are discussed in Graefe's letters, such as the ophthalmoscope, prismatic spectacles, the action of belladonna; furthermore, views are presented regarding glaucoma, the vitreous body, perforation of the retina and so forth. Mention is made of the work and studies of many men who were prominent in medicine and of others who began their careers at that time.

From these letters one gains an idea of the close mutual friendship between Graefe and Donders and of the latter's concern over Graefe's impaired health. Donders' letters in reply, unfortunately, are not preserved.

K. L. STOLL.

Lacrimal Apparatus

TWELVE HUNDRED PLASTIC DACROCYSTORHINOSTOMIES. M. AVERBACH and IVANOVA, Ann. d'ocul. **172:** 913 (Nov.) 1935.

This operation is indicated in all cases of manifest dacryocystitis, acute phlegmon and fistula. It is especially applicable when there is ectasia of the lacrimal sac; in such cases the more the secretion is held within, the easier it is to perform the operation, and the result is more satisfactory. When dacryocystitis is complicated by corneal inflammation, this operation cures not only the dacrocystitis, but also the keratitis as well as does removal of the lacrimal sac. It also gives a satisfying result in cases in which a relapse has occurred after removal of the lacrimal sac.

Pathologic conditions in the nose and adjacent cavities do not constitute a contraindication for this operation, because they may be treated during the operation, owing to the large incision necessary in the nasal mucosa. Plastic rhinostomy presents an advantage over the removal of the lacrimal sac in that it conserves the organ and reestablishes its function. The operation is not dangerous in any way and is easily done, as no special, difficult technic is required, and complications are met with no oftener than in removal of the lacrimal sac. A most important point in this operation is to make the opening as large as is needed. This assures sterility of the conjunctival sac, thus permitting operations on the globe. The only drawback may be its duration, but this diminishes as one improves in the technic.

S. H. MCKEE.

CHOLESTEROL CRYSTALS IN THE LACRIMAL SAC. M. SORIA, Arch. de oftal. hispano-am. **35:** 435 (Aug.) 1935.

This is the report of a case of dacryocystectomy in which the lacrimal sac was found to contain a greenish fluid with numerous floating

brilliant-yellow bodies, which a microscopic examination proved to be cholesterol crystals. A histologic examination revealed a mucocele with epithelial degeneration, polypoid granulomas and considerable vascularization and thickening of the wall of the sac. C. E. FINLAY.

Lens

PHOSPHOLIPID CONTENT OF CATARACTOUS HUMAN LENSES. P. W. SALIT, Brit. J. Ophth. **19:** 663 (Dec.) 1935.

The author's summary of the work done is as follows: "The phospholipid content of each of 100 cataractous human lenses was estimated. All the lenses were examined with the slit-lamp microscope and classified as incipient, intumescent, or mature cataracts, after which they were removed *in toto* by the intracapsular method. The lenses were weighed immediately after removal and the lipids were extracted successively with chloroform, ether-alcohol, and acetone. The phospholipids were estimated as lechithin by a modification of the colorimetric method of Whitehorn. In this study are included: age of the patient, stage and approximate duration of the cataract, weight of the lens, milligrams of phospholipid per lens, and per cent of phospholipid.

"The results indicate a definite decrease in phospholipids of cataractous lenses as they approach maturity. This fact is shown by both the absolute and relative values, the former decreasing from 1.075 mg. per lens in incipient cataracts to 0.971 mg. in intumescent, and 0.932 mg. in mature cataracts, and the relative values decreasing from 0.534 per cent in incipient to 0.481 per cent in intumescent, and 0.470 per cent in mature cataracts. The phospholipids, however, increase with age, both on the absolute and relative basis. This is shown by the data as arranged according to age in decades, covering all ages from 42 to 87 years inclusively; thus the absolute value of 0.904 mg. per lens or 0.453 per cent in the fifth decade is increased to 1.254 mg. per lens or 0.533 per cent in the ninth decade.

"So far it has been assumed that the phospholipid content of cataractous lenses increases as the cataract advances. This error was due chiefly to the following: (1) Omission of age; (2) failure to differentiate between intra- and extra-capsular lenses; (3) failure to classify the lenses according to the maturity of the cataract; and (4) confusion of phospholipids in their natural forms with their decomposition products, e. g., birefractive myelins, liquid spherocrystals, calcium soaps, and other birefractive substances." W. ZENTMAYER.

CATARACT DUE TO ELECTRICAL INJURIES. A. GABRIÉLIDÈS, Arch. d'opht. **52:** 394 (June) 1935.

A case of bilateral cataract following an electric shock from a current of 5,500 volts is described in some detail, including observations with the slit lamp. The condition appeared simultaneously in both eyes eleven months after the accident. The opacities were localized in the anterior capsule and the superficial layers of the cortex. The simultaneous appearance is notable, for in the majority of instances cataract appears first in one eye, the one nearest the region receiving the shock. Another interesting point is the great distance of the shock from the

eyes. In almost all the observations reported the shock involved some part of the head. There was extraordinary thickening of the anterior capsule, especially in its central portion. Gabriélidès has collected and tabulated twenty-seven cases from the literature, including his own. He discusses experimental electric cataract, first studied by Priestley in 1766. The chief anatomic change which has been observed consists in thickening of the anterior capsule, the rest of the lens remaining essentially normal. The biomicroscopic appearances are characteristic; irregular white plaques on the capsule and a fine-dotted or powdery grayish opalescent change in the anterior cortex. In twelve of twenty-four cases the cataract was bilateral, the eye nearest the shock being first affected, the other at some later time. There seems to have been no relation between the occurrence of the cataract and the strength of the current. The cataract is late in appearance, being seen from one to nineteen months after the accident. It is slow in development. The pathogenesis has not been clearly determined, but the author favors the opinion of Terrien that it is due to the mechanical and electrolytic action of the current, especially to its catalytic action. Its differential diagnosis includes the consideration of glassblowers' cataract, cataract due to the x-ray and cataract due to the infra-red ray. Its treatment is surgical.

S. B. MARLOW.

BIOCHEMICAL CHANGES IN THE EYE BROUGHT ABOUT BY NAPHTHALENE AND THE INFLUENCE OF VITAMIN C ON THEM. H. K. MÜLLER, Arch. f. Augenh. **109:** 304, 1935.

After administration of naphthalene to a series of rabbits Müller found that the lenses lost, for the time being, their ability to protect the vitamin C of the aqueous from being oxidized. As a matter of fact, the lenses of naphthalene-poisoned rabbits even caused an acceleration of the oxidation of vitamin C in the aqueous. When he administered large doses of cevitamic acid intravenously he was able to prevent the action of naphthalene in causing an increase in the rate of oxidation of vitamin C.

F. H. ADLER.

Lids

MALIGNANT ANTHRAX EDEMA. A. S. Ross and J. S. SHIPMAN, Am. J. Ophth. **18:** 641 (July) 1935.

Ross and Shipman describe the different forms of anthrax in man. They report the case of a man, aged 38, who had worked with Brazilian goat skins for eleven months. He stated that on the day preceding examination he noticed swelling of the right lower eyelid. This had progressed, and there was enormous edema of the upper and lower right eyelids, which extended from just above the brow to within 1½ inches (3.8 cm.) of the right ear and also down the right side of the face. There was no tenderness or induration. The palpebral fissure was completely closed, but the eyelids could be opened, and the globe was normal except for chemosis temporally. Ophthalmoscopy gave negative results. A diagnosis of malignant anthracic edema was made. Antianthrax serum was given intravenously and later intramuscularly.

Scabs formed on the right eyelids, and smears from a bleb revealed anthrax bacilli. The patient recovered and following three successively negative smears was discharged from the hospital. The blood cultures were negative.

W. S. REESE.

Methods of Examination

PHOTOGRAPHY OF THE EYE WITH THE MINIATURE CAMERA. R. CASTROVIEJO, Am. J. Ophth. **18:** 353 (April) 1935.

Castroviejo uses the heavy compound base of a corneal microscope on which to mount the camera, the base being equipped with cross-slide adjustable movement. Exposures are calculated with the aid of an exposure meter, and the lens is usually stopped down to f : 9 or f : 12.5. Supersensitive panchromatic film is used because of its great speed under artificial light. Several methods of illumination are used, depending on the sensitivity of the eyes.

W. S. REESE.

KINESCOPY—OBJECTIVE AND SUBJECTIVE (A PRACTICAL KINESCOPE S). S. HOLTH, Brit. J. Ophth. **19:** 603 (Nov.) 1935.

After a brief review of the history of objective kinescopy ("shadow test") Holth describes the apparatus which he now uses in subjective kinescopy. The disk is suspended on a movable horizontal rod and can be raised and lowered to heights between 0.85 and 1.5 meters. This does away with oblique fixation through spherical lenses and the resulting false astigmatism. The opening for the light is placed in contact with the center of the milk glass bulb of a 75 watt electric lamp.

W. ZENTMAYER.

SELF-EXAMINATION OF THE FUNDUS OF THE EYE. A. M. VIANNA, Ann. d'ocul. **172:** 936 (Nov.) 1935.

A method for examining the fundus of one's own eye, which was discovered by Vianna in April 1935, while of not much clinical importance, seems to Vianna to be of particular interest to ophthalmologists. It may be done only by ophthalmologists or those who are aware of ophthalmologic technic. The method is given in detail, and five technical drawings illustrate the procedure.

S. H. MCKEE.

Neurology

THE LID-CLOSURE REFLEX OF THE PUPIL. B. BOSHES and L. L. MAYER, Am. J. Ophth. **18:** 1048 (Nov.) 1935.

Boshes and Mayer report a case of the corneal reflex (eyelid closure) in a woman aged 42 who gave a history of a fall. The right pupil was dilated and did not react directly, consensually, to light or in accommodation. The left pupil reacted normally. When the eyelids were gently closed and then opened, the right pupil was tiny, conforming in size to the left. The reflex was present but not so marked in the left pupil. Physostigmine did not affect the right pupil, but atropine

caused it to enlarge from 7 to 9 mm. and abolished all reactions. Paralysis of the right orbicularis muscle with procaine hydrochloride caused the right corneal reflex to disappear. W. S. REESE.

A CASE OF CHRONIC TUBERCULOUS JUVENILE MENINGO-ENCEPHALITIS WITH PUBERTAS PRAECOX, CHOKED DISK AND BITEMPORAL HEMIANOPIA. F. Poos, Klin. Monatsbl. f. Augenh. **95:** 537 (Oct.) 1935.

Poos reports the case of a boy aged 12 whose father died from tuberculosis of the larynx and who had mutation of the voice and beginning puberty when he was 7 years old. He was apparently healthy to his eleventh year, when diabetes insipidus and polyuria developed, followed by visual disturbances and bitemporal hemianopia. His vision, which had decreased rapidly two weeks prior to his admission to the hospital, disappeared completely after eleven days. The results of the ophthalmoscopic, neurologic and roentgen examinations and of the tapping of the spinal cord are given in detail. The boy died a few days after a trephination of the skull which was done in a search for a cerebral tumor. Pathologic examination revealed caseous tuberculosis of the glands of the mesentery, chronic perihepatitis and perisplenitis. No cerebral tumor was found, but the brain substance was edematous, and edema was present in the chiasm, aside from granular ependymitis and papillary hypertrophy of the meninges near the pons. Encephalitis with granulomas and giant cells of Langhans' type was found histologically. The chronic intracranial tuberculous process, in Poos' opinion, was secondary to the mesenteric tuberculosis. K. L. STOLL.

Orbit, Eyeball and Accessory Sinuses

CRANIOFACIAL DYSOSTOSIS (CROUZON'S DISEASE). F. MÉDINGER and G. MORARD, Arch. d'opht. **52:** 489 (July) 1935.

This condition is characterized by: (1) deformities of the skull; (2) facial deformities involving the nose, orbit and superior maxilla, giving rise to prognathism of the lower jaw; (3) ocular involvement, such as exophthalmos, divergent strabismus, nystagmus and lesions of the optic nerve producing blindness; (4) hereditary and familial traits. Médinger and Morard have been able to collect eighty-three instances from the literature. Sixty-nine cases which they were able to trace occurred in thirty-nine families; forty-six were familial, twenty-three solitary. They describe a personal observation in detail. In discussing the ophthalmic symptoms they point out that exophthalmos is always present, though of varying degree. The condition is never accompanied by trophic disturbances of the cornea due to pressure on the ciliary ganglion, or with intrinsic paralysis of muscles or with high hyperopia. It is frequently accompanied by widening of the interorbital space. Divergent strabismus was present in thirty of sixty cases. Nystagmus has been observed and is probably associated with defective vision. Among sixty cases, optic atrophy was complete in fifteen and partial in eighteen; in the remaining thirty-seven cases the optic nerve was normal. The development of optic atrophy is slow and progressive and

has been found at various stages of the disease. No treatment other than the possible prevention of the occurrence of the disease is effective. A full bibliography is appended. S. B. MARLOW.

BILATERAL FAMILIAL MICROPHTHALMOS ASSOCIATED WITH CONGENITAL MACULAR DEGENERATION. G. BORSELLINO, Rassegna ital. d'ottal. **4:** 181 (March-April) 1935.

Bilateral amaurotic microphthalmos in three brothers is described; in two of the patients there were lesions of the macula and optic nerve. In the third the fundi could not be explored.

The macular changes resembled macular lesions of the familial degenerative type. These may be associated with microphthalmos.

The etiology of conditions of this type and their pathogenesis outside of an arrested development or a dystrophy have been open to many conjectures. The true factors remain unknown. V. R. SYRACUSE.

EARLY SURGICAL TREATMENT OF CAUSTIC BURNS OF THE EYEBALL: EXPERIMENTAL AND PATHOLOGIC-ANATOMIC CONSIDERATIONS. J. NEUMAN, Klin. Monatsbl. f. Augenh. **95:** 491 (Oct.) 1935.

Instead of using conservative measures in the treatment of extensive caustic burns of the eyeball Neuman removes the burnt conjunctiva directly after the accident and covers the defect with transplants of mucosa from the lip. This operation, which is described in detail, is based on the idea and the method of Denig's operation. The result of the operation was good in 41 of 50 eyes, fair in 4 and negative in 5.

A scientific foundation for the operation was obtained by experiments on rabbits and dogs. Two series of experiments were carried out, the first with the intention of producing burns of the third degree and the second to demonstrate the reason for the more favorable results obtained by early transplantation. A number of photomicrographs illustrate the text.

Neuman arrived at the following conclusions: 1. Immediate excision of the necrotic conjunctiva and transplantation of mucosa from the lip constitute the only rational therapy in severe caustic burns of the eyeball. 2. The operation must be performed directly after diagnosing necrotic changes in the conjunctiva at the limbus or in the cornea. 3. The sooner the transplantation is performed the more favorable is the prognosis. The prognosis is best when the operation is performed within four hours after the accident, and less favorable after a lapse of seven hours or more. Even then the surgical procedure is preferable to conservative treatment. K. L. STOLL.

Physiology

THE ELECTRICAL RESPONSE OF THE EYE TO LIGHT. J. PARSONS, Brit. J. Ophth. **20:** 1 (Jan.) 1936.

This is a résumé of the present knowledge of the electrical response of the eye to light. Every nerve impulse in the body is accompanied by an electrical response. After a short latent period the stimulus sets

up changes in potential following each other in rapid succession and varying from 10 to 300 per second. Each response is followed by a short refractory period during which no stimulus, however strong, produces any response. The normal, so-called adequate stimulus of any sensory end-organ produces exactly the same type of discharge in the nerves as stimulation of the nerve by artificial means, e. g., an electric shock. These laws are found to hold good for all nerves, both efferent and afferent.

If nonpolarizable electrodes are placed on the cornea and optic nerve of an animal and are joined by a wire with a galvanometer in the circuit, it is found that a current flows from the cornea through the galvanometer toward the optic nerve. This is the current of rest. If the current of rest is compensated for and light thrown on the eye a current of action is induced, but only so long as the eye survives. The current originates in the retina.

Adaptation.—The sensitivity of the retina to light is enormously increased by prolonged (one-half hour or more) exclusion of light from the eye.

Variations of great theoretical interest occur in different animals. These appear to be related to their evolutionary status, retinal structures and habits of life.

Optic Nerve Response.—The response in the optic nerve agrees in all respects with that in other nerves. Therefore, changes in the intensity of the stimulus do not cause changes in the intensity of the reaction but manifest themselves as changes in the frequency of periodic oscillations.

Increase of the intensity of the stimulus results in a reduced latent period, increased maximum frequency of the discharge and more rapid rise of the frequency curve. Increase of the area stimulated, with constant intensity, has exactly similar effects. Since the maximum frequency is not directly proportionate to the area stimulated and the latent period is reduced when the area is increased, it follows that the retina is not a mosaic of isolated points; that is, there is interaction between the points stimulated.

Analysis of Electroretinogram.—The discharge in the optic nerve commences at a fixed time after the beginning of the retinal response, irrespective of the length of the latent period of the latter. This constant delay must be due to changes in the retina and may be due either to photochemical changes or to delay in the two sets of retinal synapses through which the impulse must pass. The retinal nerve intervals for *a* and *d* waves of the electroretinogram were the same, and therefore both must be of the same nature.

Electrical Response of Human Eye.—Granit found that the curves of potential for the central and the peripheral portions of the retina are of the same type, but the curve for the peripheral portion shows lower development of potential. Intermittent stimulation gives rise to corresponding ripples on the curve.

The inadequacy of this abstract is due to the fact that the paper is technical. The article should be read in the original with the elucidation furnished by the charts. Credits for investigation are given in the original article.

W. ZENTMAYER.

EFFECT OF LACK OF OXYGEN ON DARK ADAPTATION. F. P. FISCHER and JONGBLOED, Arch. f. Augenh. **109:** 452, 1935.

Three carefully selected subjects were exposed to lowered oxygen tensions corresponding to those at heights of 9,000 and 18,000 feet above sea level and their rates of dark adaptation measured by means of the skotoptikometer of Möller and Edmund. They found that reduction in the oxygen of the atmosphere considerably delays the rate of dark adaptation. This is interpreted as a physiologic expression of the delay in resynthesis of the light-sensitive material in the retina. They conclude that oxygen is necessary for the resynthesis of this material once it is bleached.

F. H. ADLER.

Refraction and Accommodation

EXPERIENCES WITH CONTACT GLASSES. C. H. SATTLER, Klin. Monatsbl. f. Augenh. **95:** 33 (July) 1935.

In 1931 Sattler published his experiences with Müller's contact glasses and with a set of twenty afocal glasses manufactured after the device of Heine by the Carl Zeiss Company. Satisfactory optical correction and tolerance of the eye in wearing the contact glasses for several hours could be obtained in many patients.

Sattler reports on his experiences with a new type of contact glasses, manufactured also by the Carl Zeiss Company and perfected by Hartinger. Valuable detail in point and an evaluation of Dallos' contact glasses are contained in this paper. Sattler found that an unfavorable prospect for the tolerance of Zeiss' contact glasses is offered by persons who have tight eyelids, narrow palpebral fissures, considerable irritability of the conjunctiva, e. g., in smoke, and astigmatism of high degrees. The results are good in patients with soft, loose eyelids and in those with corneal scars. Contact glasses in which the radius of the optical portion is 8 mm. are more agreeable to the eye than those in which the radius is smaller, and still more than those in which it is larger. Sattler therefore recommends the use of contact glasses in which the radius of the optical portion averages 8 mm., to which the correction is ground. In a series of cases, the fittest contact glasses selected from a large number of types manufactured by the Zeiss Company proved to be those with a diameter of 22 mm.; in these the pressure of the haptic portion is distributed on a large portion of the surface of the sclera. Contact glasses with a tapering margin can be borne better than those which do not have it.

Instead of the old set of afocal glasses, a new set for testing is recommended which consists of two series: (1) for testing the optical correction, a set of contact glasses in which the optical portion has a radius of 8 mm. with ground-on additions of from 12 convex to 16 concave diopters; (2) for the haptic correction, two sets of contact glasses from 20 to 22 mm. in diameter with finely granulated radii of the haptic portion. Contact shells after Dallos' device, molded after a cast of the living eye, may benefit patients who cannot tolerate Zeiss' contact glasses, especially those with an asymmetrical anterior surface of the globe and patients with sensitive eyes.

K. L. STOLL.

Retina and Optic Nerve

THE LOCALIZATION OF THE RETINAL HOLE. J. A. VAN HEUVEN, Brit. J. Ophth. **20:** 39 (Jan.) 1936.

The method described by Van Heuven is a modification of the procedure of applying a small pencil of light to the outer surface of the sclera. A glass bar with a thickness of 3 mm. is bent in three different dimensions. At one end is a flattened knob the thickness of which varies between 2 and 1.5 mm. It has a very fine lumen through which a platinum wire runs and projects from the flattened knob. The bar is silvered and lacquered except for the space within a millimeter of the projecting wire. By means of a screw top the other end fits into an electric opthalmoscope.

The light from the ophthalmoscope is totally reflected and emerges at the end of the uncovered portion of the glass knob.

After the conjunctiva has been freed, the transilluminator is pressed against the globe somewhere near the retinal tear, and the penetrating light is viewed with the ophthalmoscope. When the light exactly corresponds with the hole, a diathermic current is passed through the wire and a small spot is burned on the sclera, which will mark the exact spot of the center of the pencil of light. The apparatus is now taken away and the therapeutic diathermic current applied, either surface coagulation alone or this combined with perforation, as the case may require. The apparatus is also useful for control of the results after treatment.

W. ZENTMAYER.

THE EVOLUTION OF THE TREATMENT OF DETACHMENT OF THE RETINA. F. TERRIEN, P. VEIL and M. A. DOLLFUS, Arch. d'opht. **52:** 153 (March) 1935.

This is a historical review of the surgical treatment of detachment of the retina. Two periods, an early one, from the seventeenth century up to 1920, and a recent one, since 1920, are referred to. Scleral puncture was first practiced by James Ware in 1805. Maître Jean in 1707 presented a description which would be modern today if the word "tears" replaced "pores of the retina." Tears were mentioned by von Graefe in 1854. In 1894 Gillet de Grandmont presented a cure by electrolysis. Chemical agents were used in 1866, iodine by Fano. Subconjunctival injections were used by Wolfe about 1890. Sourdille in 1924 reported a high percentage of cures by multiple puncture and subconjunctival injection of mercuric cyanide.

The recent period begins with the recognition of the importance of closing the tears by Gonin, who made his report in 1920. Since then Gonin's thermocautery has been supplemented under certain circumstances and by different operators by galvanocautery and chemical cautery and by diathermic coagulation, both perforating (according to Weve and Šafář) and on the surface (Larsson and most recently L. Coppez). Modern therapy has resulted in a large number of cures. It is full of promise for the future.

S. B. MARLOW.

PERIVASCULITIS RETINAE (RECURRENT RETINAL HEMORRHAGES IN ADOLESCENCE). E. VON HIPPEL, Arch. f. Ophth. **134:** 121 (Aug.) 1935.

At the last meeting of the German Ophthalmological Society (Heidelberg, 1934) Marchesani presented a new view concerning the cause of perivasculitis retinae. He declared that the various clinical and anatomic data on which the view that this disease is tuberculous had been based were insufficient and inconclusive. He had come to the conclusion that perivasculitis retinae is a part of Buerger's disease (thrombo-angiitis obliterans). This new point of view was immediately opposed by von Hippel, who now reports the results of a careful reconsideration of the anatomic and clinical material available and adds the anatomic description of a new case: A man 27 years old had painful absolute glaucoma, and the eye was enucleated. Four years before the enucleation the diagnosis of hemorrhage into the vitreous had been made. Anatomic examination revealed changes attributable to an old vascular disease, acute inflammatory changes and the results of secondary glaucoma. One artery and several veins were obliterated by a tissue which contained endothelial, epithelioid and giant cells. In some places the disease that had led to the obliteration could with certainty be diagnosed as perivasculitis. In other places it could not be decided whether the primary process was perivascular or endovascular. Some vessels exhibited still active perivasculitis. In the lower half of the eyeball was a large active inflammatory lesion of the tuberculous type. It consisted of a zone of dense lymphocytic infiltration in the outer choroid, next to which (toward the retina) was a layer of epithelioid cells with giant cells. Still farther inward followed an area of caseation in which pigmented epithelium and retina were included. The perivasculitic nodes could be considered as *probably* of tuberculous origin; the presence of typical tubercular structures elsewhere in this eye made the etiologic diagnosis *certain*. Von Hippel also found in other certainly tuberculous eyes of his collection definite signs of active or old perivasculitis. He sums up:

"1. The vascular changes (in perivasculitis) which I and others have found are partly such that the diagnosis of tuberculosis is at least the most probable one. Some of the vascular changes, however, are nonspecific. In some of these cases definitely tuberculous lesions are found in other parts of these eyes. For a considerable number of cases of periphlebitis the diagnosis of tuberculosis was and still is correct.

"2. The observations in the obliterated retinal vessels are very often the same as in thrombosis of the central vein. In both instances, at the time when the eye becomes available for pathologic study, it is impossible to determine what the initial pathologic process was.

"3. Because of the thinness and delicacy of the walls of the retinal veins the differentiation between periphlebitis, phlebitis and endoangiitis is unimportant. The retinal vessels have no perivascular lymph vessels. The inflammatory process always begins in the tissue which lies peripheral to the endothelium.

"4. In the neighborhood of old tuberculous thoracic lesions obliterated blood vessels are common.

"5. The name Buerger's thrombo-angiitis is misleading, as it creates the impression of a well characterized anatomic picture. Under the name 'endarteritis' or 'endophlebitis obliterans,' this disease has been known for a long time.

"6. I do not mean to deny that such nonspecific obliterating vascular diseases occur in the eye. In some of the cases of thrombosis of the central vein it is probable that such nonspecific endophlebitis was the cause. In the majority of the cases of perivasculitis retinae in adolescence the pathologic observations speak strongly for a specific process."

P. C. KRONFELD.

CLINICAL STUDIES ON THE ETIOLOGY OF RECURRING JUVENILE HEMORRHAGES IN THE VITREOUS: REPORT OF CASES. W. KOKOTT, Klin. Monatsbl. f. Augenh. **94:** 327 (March) 1935.

Kokott based his research on Marchesani's studies of the connection of these hemorrhages with thrombo-angiitis obliterans (Buerger). Hemorrhages originating from tuberculous foci in the choroid were excluded. Kokott accepts the view of Schieck that hemorrhages in the vitreous and retina in patients up to 30 years of age are caused by tuberculosis localized in the sheaths of the retinal veins. Other diseases, for example syphilis, may produce similar changes. Five cases of recurrent juvenile hemorrhages in the vitreous, in four of which retinal periphlebitis could be demonstrated with the ophthalmoscope, are described and discussed, with the following critical result:

1. In no case was Buerger's disease found. The symptoms of Buerger's disease are: an abnormal sensation of cold in the legs, profuse perspiration of the hands and feet, trophic disturbances of the nails, eczematoid changes in the skin, absence of the pulse of the dorsal artery of the foot and of the posterior tibial artery; disturbances of digestion, colics and cardial symptoms as a consequence of multiple focal involvements of the central nervous system; retardation of the blood current, and capillary hemorrhages noticeable with the capillary microscope.

2. Tuberculosis was present in two cases, and tuberculous disease was probable in the third case. No pathologic changes of the organism were found in two cases in which chronic uveitis existed.

3. Retinal periphlebitis with recurrent juvenile hemorrhages in the vitreous may be due to tuberculosis.

4. Marchesani's studies, however, suggest that these hemorrhages and periphlebitis of the retina form no unit. In his opinion, juvenile recurrent hemorrhages in the vitreous are associated with a localization of thrombo-angiitis obliterans in the eyeball.

K. L. STOLL.

Trachoma

SECOND NOTE ON THE PRESENCE OF INFRAMICROBIAL ELEMENTS IN THE FOLLICLES OF TRACHOMA. A. CUÉNOD and R. NATAF, Arch. d'opht. **52:** 573 (Aug.) 1935.

The punctate bodies found intracellularly and extracellularly in trachoma are of great importance in the research on and in the diagnosis

of trachoma. Because of this the authors propose to call them *plastilles,* meaning droplets of plasma. They refer to the work of Busacca and Thygeson and in a footnote give full credit to Busacca for priority. In carrying on further study of these bodies they have employed the technic devised by Weigl and other workers on infrabacteria. By this method they have been able to identify the same elements seen by other methods, confirming their previous work.

S. B. MARLOW.

MECHANICAL TREATMENT IN RESISTANT TRACHOMA. M. MEYERHOF and S. HABACHI, Rev. internat. du trachome **12:** 189 (Oct.) 1935.

The following procedure is recommended for the treatment of intractable forms of trachoma: After instillation of cocaine and epinephrine hydrochloride the lids are successively everted on a Desmarre retractor and the papillae lightly abraded with a curet or a scalpel. The area is then swabbed with a 1:1,000 solution of mercury bichloride. Further treatment is deferred for from one to three days, until the superficial false membrane disappears.

Improvement of the cornea follows the smoothing of the conjunctival roughness and is usually noted after a few treatments. The regimen is to be continued, however, for weeks or months. The treatment is also applicable after tarsectomy if disturbance is caused by some remaining trachomatous tissue.

J. E. LEBENSOHN.

INOCULATION OF TRACHOMATOUS MATERIAL INTO CHICKENS. A. VON SZILY, Klin. Monatsbl. f. Augenh. **94:** 753 (June) 1935.

In a previous paper (*Klin. Monatsbl. f. Augenh.* **93:** 135 [Aug.] 1934; abstr., ARCH. OPHTH. **13:** 669 [April] 1935) von Szily referred to his experiments in inoculating trachomatous material from human eyes into chickens. The results are described in this article. He injected 0.1 cc. of a very dilute solution into the vitreous of the eyes of a series of chickens. The follicles of the conjunctiva increased in number and size, especially in the neighborhood of the connective tissue of the lacrimal gland. The new follicles were surrounded by a dense wall of inflammatory infiltration which consisted almost exclusively of lymphocytes. Special technical precautions are recommended in avoiding lesion of the lens so that the intra-ocular process may be followed by means of the ophthalmoscope. The anterior section of the globe usually remained uninvolved, and the injected mass could be observed floating in the vitreous. The diameters of the globe were reduced in size, but practically no pathologic changes were noted in it aside from moderate infiltration of the choroid and limited serous detachment of the retina. The structures of the retina and vitreous were preserved, and phthisis bulbi was not necessarily present. An exception, however, occurred in the neighborhood of the injected mass, where the retina was detached in folds and where the vitreous was shrunken. The aspect was comparable to that produced in eyes of rabbits, which was described in a previous paper. Groups of follicles were seen in the region surrounding the injected mass; they degenerated within from two to three months after the injection, staining no longer. New follicles, however, formed

in their place, some of them at a certain distance from the injected mass within the vitreous; in it new isolated follicles sprouted out of newly formed germ cells, and mitoses were frequent. Follicles formed rarely in the choroid of the chicken. The follicles referred to were genuine trachomatous follicles, which the author differentiates from the small lymph follicles occurring in the conjunctiva and other parts of the body. A number of photomicrographs illustrate the histologic description.

K. L. STOLL.

TRACHOMA AND PARATRACHOMA. K. LINDNER, Wien. klin. Wchnschr. **48:** 1487 (Nov. 29) 1935.

Lindner divides trachoma into more stages than were outlined by MacCallan. The initial stage, lasting from three to four weeks, gives only a suspicion of the diagnosis. The second stage demonstrates the typical changes in the conjunctiva without any scar formation. This stage may exist for many years. In the third stage, scarring begins. This stage usually persists for many years, sometimes for the entire life of the patient. The fourth stage may be called the scar period. Destruction of the eyelids and cilia takes place. Scars occur in both the conjunctiva and the cornea. Pannus formation is noted especially during the second and third stages. In order to understand trachoma well it is necessary for the physician to see many thousands of patients with the disease in its various stages. In Lindner's opinion, the Giemsa stain reveals blue granules which are not a reaction product but a form of the active virus, known as initial bodies, representing a period in the morphologic development. These bodies are also found in the so-called ophthalmia of the new-born. It was thought after Neisser's description of the gonococcus that the blennorrhea of the new-born was evidence of a gonococcic infection. Since such an infection may be readily transferred to baboons while gonorrhea is not transferable it seems that the conclusion must be drawn that the inclusion blennorrhea is not of gonorrheal origin.

L. L. MAYER.

Tumors

BILATERAL EPITHELIOMA OF THE CORNEOSCLERAL MARGIN. L. DE ANDRADE, Ann. d'ocul. **172:** 897 (Nov.) 1935.

Epibulbar epithelioma may be bilateral and may be also a disease of the young. The epidermal globules in the middle of the stroma, the atypical and numerous mitoses and the tendency to invasion of epithelial cells are signs sufficient for making the histologic diagnosis. There are no certain signs for judging the malignancy of this epithelioma.

There are two main categories: benign epitheliomas and epithelial plaques. The first are small tumors with much epithelial proliferation; the second are characterized by larger formations in which the stroma has developed materially. According to Lagrange, the existence of the epidermal globules is a sign of benignancy.

The method of treatment is extirpation, complete and thorough, followed by cauterization. One may also remove the tumor by means of the electric cautery. This is easy and rapid and is good practice. This

procedure, however, has the disadvantage of destroying the tissue and does not permit histologic examination, which is very important.

There is a good photograph of the tumor and five photographs illustrating the histologic details.

S. H. McKee.

A Clinical and Histologic Contribution on Cyst of the Iris. H. Bracci-Torsi, Ann. di ottal. e clin. ocul. **63**: 65 (Jan.) 1935.

Cyst of the iris is rare. The diagnosis is easy with the aid of the slit lamp. In most cases cyst of the iris occurs after an injury to the eye. When the cyst occupies the entire anterior chamber it may be mistaken for a dislocated lens.

The patient, 27 years old, had suffered an injury to the right eye in 1917, resulting in rupture of the cornea with prolapse of the iris and traumatic cataract. On examination three months after the accident there were an adherent leukoma, a dilated pupil and a capsular cataract. Ten years later a cyst of the iris was found 2 mm. to the side of the adherent iris. The cyst was later removed surgically, and microscopic examination revealed that the wall of the cyst had two layers. The inner one consisted of connective tissue, blood vessels and pigment and the outer layer of two or three layers of cells. The cells were fusiform and oval and contained some pigment.

It is supposed that the torn iris became incarcerated in the corneal wound. Later a leukoma formed, and possibly the incarcerated iris formed a small cyst, as the microscopic examination revealed that the outer layer of the cyst was made of endothelium and the inner layer of the iris structure.

A bibliography is given.

A. Perzia.

Sarcoma of the Optic Papilla. A. Bucalossi, Ann. di ottal. e clin. ocul. **63**: 676 (Sept.) 1935.

A man of 46 was seen who had become aware of poor vision in the right eye three months before. The media were clear, and the tension was 22 mm. (Schiötz). Vision was reduced to perception of light. The disk was seen to be covered by a mass that projected into the vitreous. The retina around this was edematous. During twenty days the mass increased in size, and the retina about it became detached. Sections of the enucleated eye showed a mixed cell sarcoma containing pigment, which extened 4 mm. into the vitreous and involved the choroid on both sides of the disk. It pushed the lamina cribrosa back but had perforated it in only one small area; there a small strand of tumor tissue extended back a slight distance in the nerve. An origin from choroidal elements containing pigment which are often present in the normal disk is considered probable. The literature is reviewed.

S. R. Gifford.

A Nonpigmented Nevus of the Bulbar Conjunctiva. A. Clerici, Arch. di ottal. **42**: 436 (Nov.) 1935.

A case is reported in which sections showed the typical structure of a nevus without pigment and with numerous cysts in the stroma. The literature is reviewed.

S. R. Gifford.

Uvea

IRIDOCYCLITIS. J. H. DOGGART, Brit. M. J. **1:** 249 (Feb. 8) 1936.

This is a careful résumé of present knowledge of iridocyclitis. It does not lend itself to abstraction and should be read in the original.

Doggart shares the skepticism as to tuberculous infection of the eye and believes that even when benefit from a course of treatment with tuberculin occurs it may have augmented immunity to other organisms. Many forms of syphilitic iritis are not characteristic, and before a diagnosis is made there should be clinical evidence of syphilis elsewhere in the body, especially as the infallibility of the Wassermann reaction is questioned. The difficulty of the interpretation of focal sepsis is outlined, and it is a relief to find that he believes the tooth bogy has been greatly exaggerated, particularly as there is no clinical type of dental iridocyclitis. The importance of gonorrheal iridocyclitis is granted, and attention is drawn to the characteristic fibrinous exudate.

Though the list of well supported clinical observations is large and growing there are still many in which the etiology is obscure. Doggart classifies the general theories of causation and the results of experiments on animals, describes heterochromic cyclitis and iridocyclitis in elderly women, and outlines the treatment.

In the rush for laboratory and roentgen examinations, a careful examination of the eye must not be overlooked, and with vigilance other distinctive types of iridocyclitis should be clinically recognizable.

This is an excellent summary of a difficult subject, with sane analytic deductions which will well merit the reader's careful study.

A. KNAPP.

Vitreous

OPHTHALMOMYIASIS: REVIEW OF LITERATURE AND REPORT OF CASE OF OPHTHALMOMYIASIS INTERNA POSTERIOR. W. B. ANDERSON, Am. J. Ophth. **18:** 699 (Aug.) 1935.

Anderson reports a case of ophthalmomyiasis in which the parasite could be seen in the vitreous. He gives a brief outline of the eighteen cases reported, his being the sceond case reported in North America. It is the second case known to have occurred in an adult and the only one in which after eighteen months there was no visible injury or visual loss through the presence of the parasite.

W. S. REESE.

ACTION OF THE p_H OF THE MEDIUM ON THE STATE OF SWELLING OF THE VITREOUS BODY. E. REDSLOB and P. REISS, Ann. d'ocul. **172:** 848 (Oct.) 1935.

In many articles in the last few years, Redslob and Reiss have demonstrated in vitro and in vivo that the vitreous body undergoes modifications of swelling according to the function of p_H. They have noted particularly that it swells slowly at p_H values immediately superior to the physiologic p_H, but rapidly diminishes in volume on acidification. The vitreous becomes like jelly.

Recently Goedbloed claimed that the vitreous becomes jelly-like only when variations in the volume produced by the action of the p_H of the medium become irreversible. These opinions of Goedbloed are based on experiments done under very special conditions. Quite recently Duke-Elder, Robertson and Dawson have pointed out that the vitreous is not susceptible to swelling. Because of these contradictory opinions the authors have taken up this question again and have described the details of their technic and their results.

S. H. McKee.

Sympathetic Ophthalmia

Sympathetic Neuroretinitis. F. Farina, Rassegna ital. d'ottal. 4: 71 (Jan.-Feb.) 1935.

Nine years after a perforating injury of the left eye, attacks of neuroretinitis supervened in the right eye. The latter presented none of the attributes usually considered when the etiology involves such a factor as a tubercle, a sinus infection, multiple sclerosis, a cerebral disease, an orbital infection or an intoxication.

By exclusion, sympathetic ophthalmia was considered. There were, however, no appreciable signs of choroidal or uveal disease, even after careful search. Studies with the slit lamp discovered no changes in the cornea or vitreous.

The left eye was enucleated, following which there was complete and lasting recovery of the sympathizing eye. Histologic examination showed mononuclear round cell infiltration of the ciliary body and old uveitis.

Therefore, pure neuroretinitis or sympathy without uveal participation cannot be admitted.

V. R. Syracuse.

Therapeutics

Favorable Influence of a Double Carotid Sympathectomy in a Case of Atrophic Chorioretinitis. A. Magitot, Bull. Soc. d'opht. de Paris, July 1935, p. 408.

A woman, 37 years old, had mitral insufficiency and regurgitation with diminution of vision, a chorioretinal atrophy and sclerosis of the choroidal vessels. The trouble began in 1930 but did not become marked until February 1933. Her vision at that time was 1/20 for the right eye and 4/10 for the left. In spite of the fact that the Wassermann reaction was negative she submitted to intravenous injections of a mercurial and of acetylcholine and to treatment with sodium benzosulfoparaminophenylarsenate. However, there was improvement, and in April 1934 the vision was 4/10 for the right eye and 7/10 for the left. In June 1934 Magitot saw her for the first time. The Wassermann reaction was partially positive, and she received four injections of a bismuth preparation. In September 1934 her visual acuity had fallen to 2/10 for the right eye and to 6/10 for the left. Further antisyphilitic care with, in addition, the administration of acetylcholine, did not help, and

the vision fell to 1/10 for the right eye and 3/10 for the left. The peripheral fields were normal, but a marked annular scotoma existed. On October 23 a carotid sympathectomy was done on the left side and on November 7, on the right. Visual acuity in December 1934 was 3/10 for the right eye and 7/10 for the left. Magitot refers to Lauber's report of Sobanski's work to justify the operation. It was found that particularly in tabes with optic atrophy the retinal arterial diastolic pressure is low when the ocular tension is relatively high. The case report is given in detail.

L. L. MAYER.

Society Transactions

EDITED BY DR. JOHN HERBERT WAITE

NEW YORK ACADEMY OF MEDICINE, SECTION OF OPHTHALMOLOGY

Jan. 20, 1936

JOHN H. DUNNINGTON, M.D., *Chairman*

LEGRAND H. HARDY, M.D., *Secretary*

LENS CHANGES TYPICAL OF MYOTONIC DYSTROPHY: REPORT OF A CASE. DR. CHARLES O. RICE.

A patient had weakness of the legs following an operation. Examination showed the condition to be a myotonic dystrophy entirely independent of any previously known cause. Further examination revealed the typical lenticular opacities which have been attributed to this symptom complex.

DISCUSSION

DR. MILTON L. BERLINER: At the New York City Hospital Dr. A. T. Milhorat has made a study of more than fifty cases of dystrophy, of which about twenty-five were cases of myotonic dystrophy. Among the others were cases of myasthenia gravis, amyotonia congenita and myotonia congenita. It is interesting to note that among the instances of myotonic dystrophy there were only three in which lens opacities were observed. This is not in accordance with statements by Vogt, who believed that they were much more common.

As Dr. Rice showed, the opacities are almost always small and angular and are situated in the superficial part of the cortex, with a clear zone between the capsule and the line of disjunction. In the cases in which lenticular opacities were present the blood creatinine was very low.

SUCCESSFUL USE OF NONPENETRATING DIATHERMY IN TWO CASES OF DETACHMENT OF THE RETINA. DR. RAYMOND E. MEEK.

The two patients presented are from the service of Dr. Webb W. Weeks at the New York Eye and Ear Infirmary. In treating the detachments I made use of nonpenetrating diathermy according to the technic of Weve and Larsson. The inactive pole of the apparatus was attached to a cuff of tin applied to the arm or to the back of the patient. The active electrode, previously sterilized, was applied to the sclera. The active electrode is a thin metal rod about 1 mm. in thickness, on the extremity of which is a spherical button from 3 to 5 mm. in diameter. The current must not exceed 150 milliamperes, and the surface of the sclera has to be kept dry throughout the entire course of the operation.

The length of the application depends on the effect to be obtained. As soon as the sclera showed a grayish dry area underneath the electrode, the current was switched off and the electrode removed. The treatment was repeated on an adjoining area at a distance of a few millimeters. The area to be treated had to be encircled by these applications.

After the applications of diathermy, several punctures of the sclera and choroid were necessary to permit the escape of the subretinal fluid. This facilitated the apposition of the retina to the choroid. The Šafář needle was used. This needle is insulated up to 1 mm. from its point, which is the average thickness of the sclera. The needle, by aid of its heat, was forced through the sclera and cauterized only the choroid and retina. This was used only over the hole or holes, with a current of from 20 to 40 milliamperes, just enough to aid the needle in puncturing the sclera.

The procedure was followed by successful reattachment in each case.

DISCUSSION

DR. WEBB W. WEEKS: In these two cases the reaction which one sees in looking at the fundi is not more and seems less than the reaction which I have observed following the Šafář operation. The broader area of cohesive choroiditis set up assures one of success with this type of procedure. When the Šafář needle is put through the cauterized sclera and choroid to withdraw the subretinal fluid there is less chance of an intra-ocular hemorrhage. With the Šafář and Coppez procedures there is the advantage that one is less likely to injure the retina or damage the vitreous.

MICROSCOPIC OBSERVATIONS IN TWO EYES IN WHICH RETINAL DETACHMENT HAD BEEN TREATED BY DIATHERMY. DR. DAVID WEXLER.

The first eye was obtained following the death of the patient from pulmonary embolism on the tenth postoperative day. Sections showed marked pigmentary proliferation of the choroidal and retinal pigmented epithelium, formation of buds of granulation tissue on the free choroidal surface and migration of pigment granules into the retina. It seems evident that bleeding is a favorable occurrence, since the formation of granulation tissue, necessary in uniting the choroid with the retina, was facilitated.

In the second eye, extensive infection of the globe terminating in panophthalmitis necessitated enucleation twenty-five days after the operation.

OBLITERATION OF PERICORNEAL BLOOD VESSELS FOR VARIOUS TYPES OF KERATITIS. DR. TRYGVE GUNDERSEN.

In thirty-three patients with keratitis associated with vascularization of the cornea, the effect of interrupting the blood vessels at the limbus has been observed. These patients comprised a consecutive series in almost all of whom the disease was very chronic, resisting all standard forms of treatment. The types of keratitis encountered were classified

as follows: herpetic, 5; rosacea, 6; tuberculous, 12; traumatic, 2; interstitial lipin, 2; trachomatous, 5; ulcerative hypopyon, 1.

Obliteration of the vessels was effected by incising the limbus with a sharp needle attached to the diathermy unit. A combination of cutting and coagulating current was used. By this method, vessels could be coagulated at any depth in the cornea except at the level of Descemet's membrane without perforation of the anterior chamber. When vessels were on the posterior corneal surface, the operation was supplemented by incising the episcleral tissue surrounding the adjacent limbus, in order to destroy the anterior ciliary vessels supplying the deep portion of the cornea.

Diagrammatic drawings showing the corneal condition in each case are demonstrated, and illustrative cases are discussed in detail.

The results obtained by this operation may be summarized conservatively and briefly as follows: excellent, 8; good, 6; fair, 16; not improved, 3.

The literature regarding peritomy is reviewed, and the opposing concepts of the function of blood vessels in corneal tissues are discussed in detail. The following conclusions are drawn:

1. The so-called *Wanderphlyktäne der Cornea* are not always tuberculous in origin. A similar clinical picture may result from herpetic keratitis, injury and rosacea keratitis, as well as from ocular tuberculosis.

2. Corneal blood vessels not only cause opacification; they may also cause necrosis and an actual increase in the amount of corneal infiltration.

3. Obliteration of corneal blood vessels is an effective method of checking these lesions.

4. The high frequency diathermy apparatus is the most effective means to use in directly obliterating blood vessels at the corneal limbus.

DISCUSSION

DR. P. CHALMERS JAMESON, Brooklyn: Dr. Gundersen's observations on these groups of cases of various types of keratitis may open a surgical avenue for the amelioration of some of these obstinate conditions.

In the moderate amount of time that I have devoted to obliteration of vessels in the anterior segment I have become convinced, with Dr. Gundersen, that ciliarotomy for this purpose must, in many instances, have a salutatory effect on vascular and nutritional conditions affecting the cornea.

Dr. Gundersen's paper frequently reverses the very general opinion that corneal vascularization is primarily reparative, and that basal obliteration should be attempted only when the vascularization has served the purposes of nutrition, which is usually late in the disease. I cannot entirely subscribe to this reversal. In the acute cases reported, basal obliteration has been practiced early in the disease. It will require astute judgment to determine the time when obliteration will be beneficial or harmful. To deprive the cornea of nutrition and reparative support if required would be harmful. It should be noted, however, that in some of the acute cases reported by Dr. Gundersen in which obliteration was performed early benefit and cure resulted. A fact

which one should not pass over without comment is that in corneas treated by the usual means without destruction of the basal vessels the corneal vascularization frequently disappears.

The method used in obliteration is important. The anatomic location of the vessel supply from which the new corneal vessels spring should be studied. There are three sources of supply: (1) the superficial reticulum of conjunctival vessels, (2) the deep reticulum of subcapsular vessels and (3) the vessels which may penetrate the cornea directly from the base of the iris or from the ciliary body.

The first two can always be attacked; the third cannot safely be reached surgically.

Peritomy performed at the limbus may succeed if the new corneal vessels emerge from the superficial conjunctival reticulum. It may be a failure if the deeper reticulum is the source of supply. The deeper reticulum is harder to reach. Its vessels have a violet hue, in contradistinction to the conjunctival supply, which is bright red. The deeper reticulum is covered by a dense fibrous membrane, a contribution from the capsule, which becomes much more intimately adherent to the sclera anterior to the muscle insertions. A peritomy will not reach this region.

With regard to the agent used for obliteration of this region, I can conceive that coagulation diathermy can be very useful when applied with care and when sealing of vessels is indicated. When a large area has to be covered, as for markedly congested supraciliary deep reticulum, the surgical procedure would, I feel, be safer from damage to the ciliary body, choroid and adjacent structures, and the drainage of the ciliary body, if required, more complete. This method I have described in the

ARCHIVES OF OPHTHALMOLOGY (**9**: 523 [April] 1933).

I am convinced that if nature demands nutritional support by the agency of new corneal vessels such support will be obtained irrespective of what is done; if it is drawn from an iritic or a ciliary source, as it may be, the area cannot be reached surgically. The operator then has recourse to destruction by direct attack on the cornea with curettage or other method.

DR. TRYGVE GUNDERSEN: I did not mean to minimize the importance of what Dr. Jameson calls the reticular supply. The point was probably not emphasized that when the corneal blood vessels are at the level of Descemet's membrane it might be hazardous to obliterate them by a direct attack through the sclerocorneal stroma with the diathermy needle.

I wish to repeat that pericorneal vascular obliteration will not cure patients with active phlyctenular keratitis, herpetic keratitis or other types of infectious keratitis even though their corneas show vascularization, but I believe that a substance carried into the corneas by blood vessels is capable of producing tissue necrosis. Furthermore, if one were able to differentiate between active infectious keratitis and keratitis due to the activity of blood vessels alone and were able permanently to obliterate all the corneal vessels involved in the latter, one could stop the latter pathologic process.

INTRACAPSULAR CATARACT EXTRACTION: THE INDICATIONS AND THE METHODS. DR. ARNOLD KNAPP.

This paper will be published in full in a later issue of the ARCHIVES.

ROYAL SOCIETY OF MEDICINE, LONDON, SECTION OF OPHTHALMOLOGY

Feb. 14, 1936

MR. RANSOM PICKARD, C.B., M.S., *President*

VITAMINS IN OPHTHALMOLOGY. MR. JOHN FOSTER, F.R.C.S.

The specific effect of vitamin A is on the epithelium of the body (mucous and squamous) and on the nerve cells. Deficiency of this vitamin causes excessive keratinization, which is followed by local infection. Its source is "green things of the land and sea," and in animals it is concentrated in the liver, its main storage place, and the retina. It is found in most animal fats, including cod liver oil, butter, milk and eggs, but not in lard. A minor deficiency of the vitamin affects the eyes of men and rats, producing hemeralopia. In rats hemeralopia has been shown to be due to poor regeneration of the visual purple after exposure to strong light, a stimulus which breaks down the visual purple into vitamin A and visual yellow. A more marked deficiency causes xerophthalmia. In the rat with xerophthalmia, the corneal surface is bright, oily and covered with fatlike plaques, and it may ulcerate, whereas with deficiency of vitamin G most of the pathologic changes in the cornea are situated in the anterior layers of the stroma, and ulceration does not occur. In the rat, cataract does not occur as a result of a deficiency of vitamin A. The xerophthalmia of man is not dissimilar from that of the rat, and xerosis in man is characterized by Bitot's spots, pigmentation and wrinkling of the conjunctiva and keratomalacia. Knypers suggests that infantile eczema may be the result of a deficiency of this vitamin. The disease is often associated with phlyctenules.

Vitamin B is found in fresh yeast, liver, milk and, to some extent, fruit. Its absence causes pellagra. Rats fed on a diet deficient in vitamin B showed (1) mucopurulent exudates in the cutaneous surface of the eyelids, (2) anterior interstitial keratitis resulting in normal epithelium and vascularization beneath it in the cornea, and (3) proliferation of the epithelium of the lens and breaking down of the lens fibers directly beneath the capsule.

Vitamin C (the antiscorbutic vitamin) is found in lemons, potatoes and most fresh foods such as meat and milk, and it is destroyed by pasteurization or boiling. In the body it is concentrated in the adrenal gland. Deficiency of this vitamin causes disease in the dental pulp and generalized hemorrhages. An appreciable amount of this vitamin can be detected in the normal lens and aqueous humor; in the cataractous lens the amount is reduced.

The antirachitic vitamin D is found in cod liver oil, but no common foodstuff is rich in it. It has now been synthesized as viosterol. The

effect of deficiency on the eyes is indirect. The association of lamellar cataract with rickets, tetanic convulsions and malformation of the teeth is well known. Viosterol administered in excessive amounts to children who are taking sun baths has caused follicular conjunctivitis, the condition disappearing when the drug has been withdrawn.

Vitamin E is known as the antisterility vitamin. It is found in green stuff and, in higher concentration, in wheat germ oil, which does not contain vitamin C.

DISCUSSION

MR. LINDSAY REA: The worst case of keratomalacia I have seen was in an Indian student who, in the first part of his residence in England, kept strictly to the kind of food which he had been having in India; he was physically a miserable specimen. His corneas were wrinkled, and around the margin was vascularization. After he had been prevailed on to take a diet suitable to the English climate, the corneas recovered completely.

ALLERGIC TESTS IN CONNECTION WITH EXTERNAL OCULAR CONDITIONS. MR. ARNOLD SORSBY and MISS L. R. BENHAM.

The question of allergy in man is bound up closely with the advances in bacteriology. The introduction of vaccines led to the discovery that increasing doses of organisms can be tolerated by human beings if the increases are properly regulated. There is also in man an increasing intolerance or hypersensitiveness to foreign bodies introduced into the system. When a foreign body is introduced into the organism there may be (1) no effect, (2) an induction of immunity or (3) a development of hypersensitiveness or anaphylaxis. In some persons allergy is inborn; in others it is acquired. A person may be hypersensitive to some substances and immune to others at the same time. If the body is sensitized to a foreign protein, the eye takes part in the responding sensitization, and the inflammatory reaction in the eye can be explained as part of the response of the body to proteins of nonbacterial origin. It is very rare that spirochetes can be found in the cornea. The course of interstitial keratitis is different from that of the condition arising on experimental introduction of spirochetes into the cornea. The treatment of syphilis does not give the same results in interstitial keratitis as it does in other syphilitic involvements.

There is little material available on which to build up a case in favor of an influence exerted by allergy in ocular conditions. Many suggestions have been made which are attractive, but they lack experimental and clinical support. One suggestion is that keratitis is a result of sensitization of the cornea by the débris thrown out in the course of ulceration, the broken-down tissue acting as a foreign body and sensitizing the cornea. Many efforts have been made to prove that cataract is an allergic condition, i. e., that cataract is an allergic reaction to lens protein itself, but the data on which the suggestion is advanced are unreliable. It seems there is a possible scope for ocular allergy in trachomatous keratitis, interstitial keratitis, cataract and sympathetic ophthalmia. At the White Oak Hospital in Swanley, England, 292 patients were tested with regard to their sensitivity to protein; 60 had phlyctenular

ophthalmia, 67 conjunctivitis, 48 trachoma, 81 blepharitis and 36 interstitial keratitis. In all the 292 patients there was only one positive result.

With regard to proteose treatment, the problem surrounding this is still unsolved. H. W. Barber (dermatologist) says it is unnecessary to find out the particular substance to which an allergic patient is sensitive, as the patient produces his own antibodies, and they are excreted in the urine. If what Barber says is true, it represents an advance. Martyn and Mills have published a paper on 46 patients with ocular conditions treated with proteose, all of whom did extremely well. This paper, which was read before the American Medical Association, was severely criticized, as no evidence was submitted in proof that the patients were allergic.

DISCUSSION

MR. F. T. RIDLEY: I am sorry that no allusion has been made to the recent work of Julianelle on this subject. It was shown that the application of protein to the eye without first scarifying the site of application gave only negative results. It has been shown that by injecting a foreign protein, such as egg-white or the protein of the pneumococcus, into the cornea for some weeks one can sensitize it to that protein, and if one keeps on provoking allergic responses in this way one produces a pannus and a revascularization on the keratitis like the vascularization seen in ophthalmologic practice. There seems no reason why a sensitization provoked by the toxins of Staphylococcus aureus should give rise to a general sensitization to male fern or to anything else.

Clinical Meeting, March 13, 1936

MR. RANSOM PICKARD, C.B., M.S., *President*

A MENINGIOMA OF THE OPTIC NERVE WITHIN THE ORBIT. DR. RUSSELL BRAIN and MR. HUGH CAIRNS.

In a woman of 41 years there was a gradually progressive ocular proptosis and, later, a bitemporal hemianopia. The optic foramen on the side of the proptosis was larger than that on the opposite side. On account of the defects of the visual fields, it was decided to approach the tumor from the intracranial aspect rather than to remove the contents of the orbit. At the operation a tumor the size of a walnut was found inside the cranium, in appearance like a suprasellar meningioma; another tumor of similar size was found in the orbit itself. The roof of the orbit was taken away; the orbital tumor was removed from behind forward, and in pulling on the tumor it was found to extend almost to the back of the eyeball. There was an extension of the tumor in the subarachnoid sheath of the optic nerve to the eyeball. Tissue sections showed the tumor to be a meningioma.

DISCUSSION

MR. FRANK JULER: I encountered a meningioma that was attached to the optic nerve. Not all the tumor could be removed, but three years after the operation there is still no evidence in the socket of recurrent growth. Sometimes these tumors are of an innocent nature and stop growing.

TREATMENT OF FAMILIAL RETINOBLASTOMA WITH RADON SEEDS. MR. H. B. STALLARD.

A boy 2½ years of age had the left eye excised on account of retinoblastoma. A large growth was later found in the lower quadrant of the remaining eye. Four radon seeds were sutured to the sclera under a conjunctival flap; the seeds were spaced 7 or 8 mm. apart because a previous investigation had shown that a destruction of growth occurred to a distance of 4 mm. all round the seed. In two months the growth had melted away, and now, one and a half years later, there has been no sign of recurrence. The father also had retinoblastoma in both eyes. When he was 14 months of age his left eye was excised on this account; two small islands were seen in the other eye, but the mother refused operation on it. At 4 years of age he contracted scarlet fever, and then the two areas of growth disappeared. The other child of this family is now 2 years of age and has both eyes completely filled with tumor tissue, a condition noted at birth.

A SARCOMA OF THE CILIARY BODY. MR. H. B. STALLARD.

A man aged 24 was seen in August 1935 with a growth which extended from the 2 to the 6 o'clock meridian and into the vitreous as far as the midplane of the eye. He was advised to have the eye excised but requested radium treatment. Three seeds of 2 millicuries each were sutured to the sclera, 8 mm. apart. In the ensuing two months the growth became smaller and less tense; again enucleation was advised and refused. Therefore two radon seeds were inserted into the growth through incisions in the sclera. The growth is now smaller than it was and is more translucent than deeply pigmented growths usually are. But sarcoma is much more radioresistant than glioma, and it is still the consensus that the eye should be enucleated.

RODENT ULCER. MR. JOHN COGAN.

A young unmarried woman came to the hospital seven weeks ago with a rodent ulcer of eighteen months' duration at the inner canthus, adajacent to the upper and lower canaliculi and puncta. Fluid did not pass through the lacrimal passages. Biopsy showed rodent ulcer. After roentgen therapy examination showed that the skin had healed and that the lacrimal passages were patent.

BILATERAL SUBHYALOID HEMORRHAGES AND RETINAL HEMORRHAGES IN A PATIENT WITH SEVERE PERNICIOUS ANEMIA. MR. JOHN COGAN.

The patient was admitted to the hospital acutely ill after severe bleeding of the nose for three days. The red blood cell count was

900,000 with 20 per cent hemoglobin, and the color index was 1.3. The vision in the right eye was 6/6. The left eye had subhyaloid and retinal hemorrhages and a vision of 6/60. The treatment commenced with injections of liver extract, but the condition did not materially improve. The patient was then given several blood transfusions, after which the red blood cell count was 3,000,000 and the hemoglobin 65 per cent. Subhyaloid hemorrhages were still present.

THIRD NERVE PALSY; ANEURYSM OF THE POSTERIOR COMMUNICATING ARTERY; LIGATION OF THE INTERNAL CAROTID ARTERY. DR. RUSSELL BRAIN and MR. D. W. NORTHFIELD.

DR. RUSSELL BRAIN: Intracranial aneurysm is far commoner than it was thought to be even ten years ago. This patient is a married woman aged 41. As in this instance, the onset of the ophthalmoplegia is often sudden, and there is associated severe headache owing to leakage from the aneurysmal sac. In a small number of cases there is a progressive nerve palsy, and the onset of symptoms is insidious, with little or no headache at first. One should think of the possibility of aneurysm before asking a surgical colleague to verify it.

MR. D. W. NORTHFIELD: Colloidal thorium dioxide was injected into the artery, the x-ray picture of which is shown. The internal carotid artery was ligated by means of two strands of no. 2 silk, and since then there has been a progressive and fairly rapid improvement both in the ptosis and in the inward and downward movement of the right eye. The pupil is still more or less completely fixed with regard to both light and accommodation. There seems to be no danger arising from the use of this opaque substance if no more than 15 cc. is injected; there is no evidence that it has a toxic effect on the body generally.

THIRD NERVE PALSY FOLLOWING DENTAL EXTRACTION. DR. W. RUSSELL BRAIN.

The phrase "caused by" has been avoided as the occurrence of the palsy after the extraction of the tooth may have been a coincidence. The tooth extracted was a right upper lateral incisor, and two days later diplopia developed. Two days later still the right eyelid drooped, and pain was experienced behind the right eye. In a fortnight after the extraction there was incomplete ptosis of the right upper lid, the right pupil was dilated and fixed, and there was complete paralysis of the external ocular muscles innervated by the right third nerve. Two weeks later improvement set in, but remains of the palsy are still evident. The Wassermann reaction was negative.

ANGIOMATA RETINAE (HIPPEL'S DISEASE). MR. HUMPHREY NEAME.

This woman complained of failing vision in the left eye for three months. Vision on the right was 6/5, and that on the left was 4/60, both with correction. In the right eye was a small angioma in the retinal periphery. In the left eye there were two adjacent angiomas of different sizes. The left eye was treated by electrolysis, a special needle with a cutting edge and an insulated shank being used with a view to reap-

plying electrolysis in a way similar to that in dealing with spider nevus (naevus araneosus) of the skin.

A Case of Keratitis Caused by Mustard Gas. Mr. Harold Ridley.

The patient, a man aged 56, in 1918 for ten days was blinded by mustard gas. When he was examined for a pension in 1919 and 1921 the vision in each eye, with correction, was 6/6, and the corneas were said to be normal. Recently there occurred a gradual diminution of vision; in the left eye the vision is now no more than 6/60 with correction. Both corneas in the interpalpebral areas exhibit opacities. The epithelium is irregular, exhibiting a polychromatic luster suggestive of crystals, and the corneal sensation is much reduced.

The cases of this kind that have been reported in the literature showed slow but steady progress of the disease. Thickening of the nerve endings has been suggested as a cause.

Arachnodactylia and Dislocated Lens. Mr. C. Shapland (for Mr. Maurice Whiting).

A patient aged 18 was admitted to the hospital in 1933, when arachnodactylia and dislocated lens were found. Mr. Whiting did an iridectomy in the right eye without improving the visual acuity.

Wilson's Disease (Progressive Lenticular Degeneration) with Kayser-Fleischer Ring. Mr. McArdle.

This patient, a girl aged 17, was admitted to the National Hospital for Nerve Diseases on account of increasing tremor in the right hand, which had been present two years. For four months speech had been indistinct. At 10 years of age there was difficulty in walking, which was then attributed to rheumatic pains in the legs. She was backward at school, and her memory was poor. Her speech is slow, syllabic and monotonous. A ring of brown pigment can be seen near the limbus of the cornea, gradually fading off toward the center. Mr. Williamson-Noble reported on the appearance when examined with the slit lamp to the effect that the brown pigment forms a definite ring in Descemet's membrane, about 5 mm. wide, starting 1 mm. from the corneal margin. Between the outer edge of the ring of pigment and the margin of the cornea there is a ring of greenish opalescent dots very closely set together.

DISCUSSION

Dr. J. G. Greenfield: My colleagues and I have examined two specimens from cases of this kind in our laboratory, and we find that the pigment is confined to the upper part of Descemet's membrane; it does not reach to the edge of the cornea; it consists of very fine granules, less than a micron in diameter. Some thought these might be silver; others, that they might be copper. They do not correspond to any of the known pigments derived from the blood but are closely allied, particularly in their insolubility in weak acids and their solubility in alkalis, to malarial pigment, which is derived from the blood. It may be some pigment derived from hemoglobin.

Book Reviews

Ninth Annual Report (1934) of the Giza Memorial Ophthalmic Laboratory. Price, 25 piasters. Cairo: Schindler's Press, 1935.

The ninth annual report of the Giza Memorial Ophthalmic Laboratory records under four headings the scientific work for the year 1934.

Under the heading postgraduate education are described the courses in medical and surgical ophthalmology given during the months of April and October for recent graduates desiring to enter the government ophthalmic service. Examinations were held at the end of each session.

In the pathologic section are listed the microscopic observations on 571 specimens submitted from the sixty-four government ophthalmic hospitals. Fifteen of the most interesting specimens, including specimens of molluscum contagiosum and angiosarcoma of the eyelid, adenoma of the meibomian gland, bone formation in the tarsus following trachoma, fibroma of the bulbar conjunctiva and basal cell carcinoma from a patient with xeroderma pigmentosum, are described in detail and illustrated with photomicrographs.

There were 2,819 routine bacteriologic examinations of smears of material from eyes with acute ophthalmia. A graph in which the frequency of Koch-Weeks' and gonococcic ophthalmia is plotted against the mean maximum temperature and relative humidity for each month confirms the conclusions drawn in the 1933 report as to the relationship of climatic conditions to the seasonal incidence of the ophthalmias.

In the clinical section are reported the results of the examination of 1,804 patients referred for diagnosis and treatment. Photographs and brief descriptions are given in connection with many of the interesting cases; 5 of the more important ones, including one of crystalline degeneration of the cornea, one of dendritic keratitis and one of subhyaloid exudation at the macula, are described in detail, and 3 are illustrated with colored plates.

The research section includes studies by A. F. El-Tobgy, Ibrahim A. Mohamed, F. H. Stewart and R. P. Wilson. Wilson has continued his experiments on the prophylactic treatment of trachoma begun at Bahtim village three years ago. The daily treatment of infants with various antiseptics, begun about the second week of life, has failed to prevent trachoma and the ophthalmias but seems to have delayed their onset and diminished their severity.

Stewart reports only 1 successful attempt in 5 to filter trachoma virus through Elford graded collodion membranes (0.7 micron, average pore diameter). He has continued his studies of the Halberstaedter-Prowazek inclusion body and has found it in 13 of 77 cases of trachoma. He has failed to find free initial bodies (Linder) in Egyptian trachoma.

Mohamed, in a bacteriologic study of gonorrheal ophthalmia, reports that gonococci are demonstrable in epithelial scrapings several days after all discharge has stopped. He observed that the cultural characteristics of ophthalmic and urethral strains are essentially the same. All the

ophthalmic strains studied were serologically related but could be divided into three subgroups by agglutinin absorption.

El-Tobgy reports that in cases of argyrosis Descemet's membrane has a special affinity for silver salts but that the precipitation does not interfere with vision. He has employed with success Weymann's potassium ferricyanide-sodium thiosulfate method for removal of the conjunctival staining. He also describes a plastic operation for restoration of the upper lid in cases in which complete removal has been necessitated by a malignant growth. He uses a pedicle graft which includes skin and cartilage from the back of the ear.

Wilson and El-Tobgy report that on the whole the endemic diseases in Egypt, with the exception of leprosy, produce few ocular complications. Intestinal infections, such as bilharziasis, ancylostomiasis and ascariasis, appear to increase the incidence of xerosis of the conjunctiva and cornea.

PHILLIPS THYGESON.

Directory of Ophthalmologic Societies *

INTERNATIONAL

International Association for Prevention of Blindness

President: Prof. F. de Lapersonne, 217 Faubourg St. Honoré, Paris.
Secretary-General: Prof. M. Van Duyse, Université de Gand, Gand, Prov. Ostflandern, Belgium.

International Ophthalmologic Congress

Secretary: Dr. E. Marx, Costzeedijk 316, Rotterdam, Holland.
Place: Cairo. Time: December 1937.

FOREIGN

British Medical Association, Section on Ophthalmology

President: Dr. P. E. H. Adams, 6, Holywell, Oxford.
Secretary: Dr. Thomasina Belt, 13, Mitchell Ave., Jesmond, Newcastle-on-Tyne.
Place: Oxford. Time: July 22-24, 1936.

Ophthalmology Society of Bombay

President: Dr. D. D. Sathaye, 127 Girgaum Road, Bombay 4.
Secretary: Dr. H. D. Dastur, Dadar, Bombay 14.
Place: H. B. A. Free Ophthalmic Hospital, Parel, Bombay 12. Time: First Friday of every month.

Ophthalmological Society of the United Kingdom

President: Mr. R. Foster Moore, 53, Harley St., London, W. I.
Secretary: Miss Ida Mann, 7, Wimpole St., London, W. I.

Oxford Ophthalmological Congress

Master: Dr. C. G. Russ Wood, Hill House, Abberbury Rd., Iffley, Oxford, England.
Hon. Secretary-Treasurer: Dr. F. A. Anderson, 12 St. John's Hill, Shrewsbury, England.

Royal Society of Medicine, Section of Ophthalmology

President: Dr. Ransom Pickard, 31, East Southernhay, Exeter, England.
Secretary: Dr. A. Rugg-Gunn, 35, Harley St., London, W. 1.

Société Française d'Ophthalmologie

Secretary: Dr. René Onfray, 6 avenue de la Motte Picquet, Paris 7è.

Society of Swedish Ophthalmologists

President: Prof. F. Berg, Uppsala, Sweden.
Secretary: Dr. K. O. Granström, Södermalmstorg 4 III tr., Stockholm, Sö., Sweden.

German Ophthalmological Society

President: Prof. Lohlein, Jena.
Secretary: Prof. A. Wagenmann, Heidelberg.
Place: Heidelberg. Time: July 6-8, 1936.

Chinese Ophthalmological Society of Peiping

President: Dr. H. T. Pi, Peiping Union Medical College, Peiping.
Secretary: Dr. C. K. Lin, 180 Hsi-Lo-yen, Chienmeng, Peiping.
Place: Peiping Union Medical College, Peiping. Time: Last Friday of each month.

* Secretaries of societies are requested to furnish the information necessary to make this list complete and to keep it up to date.

Tsinan Ophthalmological Society

Chairman: Dr. Eugene Chan, Cheeloo University School of Medicine, Tsinan, Shantung.
Place: Cheeloo University School of Medicine. Time: Last Thursday of alternate months.

NATIONAL

American Medical Association, Scientific Assembly, Section on Ophthalmology

Chairman: Dr. John Green, 3720 Washington Blvd., St. Louis.
Secretary: Dr. Parker Heath, 1553 Woodward Ave., Detroit.
Place: Kansas City, Mo.: Time: May 11-15, 1936.

American Academy of Ophthalmology and Otolaryngology

President: Dr. Frank E. Burch, 408 Peter St., St. Paul.
Executive Secretary-Treasurer: Dr. William P. Wherry, 1500 Medical Arts Bldg., Omaha.
Place: New York. Time: Sept. 26 to Oct. 3, 1936.

American Ophthalmological Society

President: Dr. L. S. Greene, 1710 Rhode Island Ave., N. W., Washington, D. C.
Secretary-Treasurer: Dr. J. Milton Griscom, 2213 Walnut St., Philadelphia.
Place: Hot Springs, Va. Time: June 1-3, 1936.

National Society for the Prevention of Blindness

President: Mr. William Fellowes Morgan, 50 W. 50th St., New York.
Managing Director: Mr. Lewis H. Carris, 50 W. 50th St., New York.

SECTIONAL

New England Ophthalmological Society

President: Dr. James J. Regan, 520 Commonwealth Ave., Boston.
Secretary-Treasurer: Dr. William P. Beetham, 5 Bay State Road, Boston.
Place: Massachusetts Eye and Ear Infirmary, 243 Charles St., Boston, Time: 8 p. m., third Tuesday of each month from November to April, inclusive.

Pacific Coast Oto-Ophthalmological Society

President: Dr. A. J. Ridges, Walker Bldg., Salt Lake City, Utah.
Secretary-Treasurer: Dr. Frederick C. Cordes, 384 Post St., San Francisco.
Place: Salt Lake City, Utah. Time: Spring, 1937.

Puget Sound Academy of Ophthalmology and Oto-Laryngology

President: Dr. L. H. Klemptner, 509 Olive St., Seattle.
Secretary-Treasurer: Dr. Purman Dorman, Virginia Mason Hospital, Seattle.
Place: Seattle. Time: January 1937.

Rock River Valley Eye, Ear, Nose and Throat Society

President: Dr. W. R. Fringer, 228 S. Main St., Rockford, Ill.
Secretary-Treasurer: Dr. W. H. Elmer, 321 W. State St., Rockford, Ill.
Place: Rockford, Ill., Janesville or Beloit, Wis. Time: Third Tuesday of each month.

Saginaw Valley Academy of Ophthalmology and Otolaryngology

President: Dr. Robert Griswell, 707 Washington Ave., Bay City, Mich.
Secretary-Treasurer: Dr. W. K. Slack, 308 Eddy Bldg., Saginaw, Mich.
Place: Saginaw, Mich., or Bay City, Mich. Time: Second Tuesday of each month, except July and August.

Sioux Valley Eye and Ear Academy

President: Dr. L. H. Hohf, Yankton, S. D.
Secretary-Treasurer: Dr. J. C. Decker, Francis Bldg., Sioux City, Iowa.

Southern Medical Association, Section on Eye, Ear, Nose and Throat

Chairman: Dr. William A. Wagner, 914 American Bank Bldg., New Orleans.
Secretary: Dr. O. M. Marchman, Medical Arts Bldg., Dallas, Texas.

Southwestern Michigan Triological Society

President: Dr. O. B. McGillicuddy, 1908 Capitol Band Tower, Lansing, Mich.
Secretary-Treasurer: Dr. Maurice C. Loree, 120 W. Hillsdale St., Lansing, Mich.
Time: Third Thursday of alternate months.

Western Pennsylvania Eye, Ear, Nose and Throat Society

President: Dr. Leslie R. Hazlett, 100 S. Main St., Butler.
Secretary-Treasurer: Dr. C. W. Beals, 41 N. Brady St., DuBois.

STATE

Colorado Ophthalmological Society

President: A presiding officer is selected for each meeting alternately until all members have served.
Secretary: Dr. Edna M. Reynolds, 227, 16th St., Denver.
Place: Capitol Life Building, Denver. Time: 7:30 p. m., third Saturday of the month, October to April, inclusive.

Connecticut State Medical Society, Section on Eye, Ear, Nose and Throat

President: Dr. Walter L. Hogan, 750 Main St., Hartford.
Secretary-Treasurer: Dr. Shirley H. Baron, 309 State St., New London.
Time: May, November.

Eye, Ear, Nose and Throat Club of Georgia

President: Dr. B. H. Minchew, 701 Elizabeth St., Waycross, Ga.
Secretary-Treasurer: Dr. Edward S. Wright, 1001 Medical Arts Bldg., Atlanta, Ga.
Place: Savannah. Time: May 12-15, 1936.

Indiana Academy of Ophthalmology and Oto-Laryngology

President: Dr. J. R. Dillinger, French Lick.
Secretary: Dr. Frederick V. Overman, 705 Hume-Mansure Bldg., Indianapolis.

Iowa Academy of Ophthalmology and Oto-Laryngology

President: Dr. Edwin Cobb, 307 Masonic Temple, Marshalltown.
Secretary-Treasurer: Dr. O. L. Thorburn, 213½ Main St., Ames.
Place: Marshalltown. Time: September 1936.

Michigan State Medical Society, Section of Ophthalmology and Otolaryngology

Chairman: Dr. Parker Heath, 1553 Woodward Ave., Detroit.
Secretary: Dr. D. R. Heetderks, 26 Sheldon Ave., S. E., Grand Rapids.

Minnesota Academy of Ophthalmology and Oto-Laryngology

President: Dr. H. E. Binger, 350 St. Peter St., St. Paul.
Secretary-Treasurer: Dr. Walter E. Camp, Medical Arts Bldg., Minneapolis.
Place: St. Paul. Time: May 1936.

Montana Academy of Oto-Ophthalmology

President: Dr. Edward S. Murphy, Northern Pacific Hosp., Missoula.
Secretary: Dr. A. W. Morse, 507 Phoenix Bldg., Butte.

New Jersey State Medical Society, Section on Ophthalmology, Otology and Rhinolaryngology

Chairman: Dr. C. Coulter Charlton, 124 S. Illinois Ave., Atlantic City.
Secretary: Dr. H. L. Harley, 124 S. Indiana Ave., Atlantic City.

New York State Medical Society, Eye, Ear, Nose and Throat Section

Chairman: Dr. John F. Fairbain, 925 Delaware Ave., Buffalo.
Secretary: Dr. Walter S. Atkinson, 168 Sterling St., Watertown.

North Carolina Eye, Ear, Nose and Throat Society

President: Dr. Burton W. Fassett, Geer Bldg., Durham.
Secretary-Treasurer: Dr. Casper W. Jennings, 332 N. Elm St., Greensboro.
Place: Durham. Time: October 1936.

North Dakota Academy of Ophthalmology and Oto-Laryngology

President: Dr. Trygve Oftedal, 55½ Broadway, Fargo.
Secretary-Treasurer: Dr. F. L. Wicks, 514 6th St., Valley City.
Place: Jamestown. Time: May 1936.

Oregon Academy of Ophthalmology and Oto-Laryngology

President: Dr. A. B. Dykman, Medical Dental Bldg., Portland.
Secretary-Treasurer: Dr. Andrew J. Browning, 418 Mayer Bldg., Portland.
Place: Good Samaritan Hospital. Time: Third Tuesday of each month.

Rhode Island Ophthalmological and Otological Society

Acting President: Dr. Nathan Bolotow, 108 Waterman St., Providence.
Secretary and Treasurer: Dr. Gordon J. McCurdy, 122 Waterman St., Providence.
Place: Rhode Island Medical Library. Time: 8:30 p. m., second Thursday in October, December, February and April.

South Carolina Society of Ophthalmology and Otolaryngology

President: Dr. R. E. Houston, 103 E. North St., Greenville.
Secretary: Dr. J. W. Jervey Jr., 101 Church St., Greenville.

Tennessee Academy of Ophthalmology and Otolaryngology

President: Dr. W. W. Potter, 601 Walnut St., Knoxville.
Secretary-Treasurer: Dr. W. D. Stinson, 248 Madison Ave., Memphis.

Texas Ophthalmological and Oto-Laryngological Society

President: Dr. T. E. Fuller, 100 W. Board St., Texarkana, Texas.
Secretary: Dr. O. M. Marchman, 1719 Pacific Ave., Dallas.

Utah Ophthalmological Society

President: Dr. V. P. White, 143½ S. Main St., Salt Lake City.
Secretary-Treasurer: Dr. E. B. Fairbanks, Boston Bldg., Salt Lake City.
Time: Third Monday of each month.

Virginia Society of Oto-Laryngology and Ophthalmology

President: Dr. Emory Hill, 501 E. Franklin St., Richmond.
Secretary-Treasurer: Dr. George G. Hankins, Medical Arts Bldg., Newport News.
Place: Richmond. Time: May 1936.

West Virginia State Medical Association, Eye, Ear, Nose and Throat Section

President: Dr. F. O. Marple, First Huntington National Bank Bldg., Huntington.
Secretary: Dr. J. E. Blaydes, First National Bank, Bluefield.

LOCAL

Academy of Medicine of Northern New Jersey, Section on Eye, Ear, Nose and Throat

President: Dr. B. E. Failing, 31 Lincoln Park, Newark, N. J.
Secretary: Dr. A. Russell Sherman, 671 Broad St., Newark, N. J.
Place: 91 Lincoln Park South, Newark. Time: 8:45 p. m., second Monday of each month, October to May.

Atlanta Eye, Ear, Nose and Throat Society

President: Dr. William O. Martin Jr., 478 Peachtree St., Atlanta, Ga.
Secretary: Dr. A. V. Hallum, 478 Peachtree St., Atlanta, Ga.
Place: Academy of Medicine, 38 Prescott St. Time: Second Friday of each month from October to May.

Baltimore Medical Society, Section on Ophthalmology

Chairman: Dr. Jesse W. Downey Jr., 529 N. Charles St., Baltimore.
Secretary: Dr. Mary L. Small, 18 W. Read St., Baltimore.
Place: Medical and Chirurgical Faculty, 1211 Cathedral St. Time: 8:30 p. m., fourth Thursday of each month from October to May.

Brooklyn Ophthalmological Society

President: Dr. John H. Bailey, 855 St. Marks Ave., Brooklyn.
Secretary-Treasurer: Dr. George Freiman, 703 Grand St., Brooklyn.
Place: Kings County Medical Society Bldg., 1313 Bedford Ave. Time: Third Thursday in February, April, May, October and December.

Buffalo Ophthalmologic Club

President: Dr. Thurber LeWin, 112 Linwood Ave., Buffalo.
Secretary-Treasurer: Dr. I. J. Koenig, 40 North St., Buffalo.
Time: Second Thursday of each month.

Chattanooga Society of Ophthalmology and Otolaryngology

President: Each member, in alphabetical order.
Secretary: Dr. A. H. Benz, 706 Medical Arts Bldg., Chattanooga.
Place: Mountain City Club. Time: Second Thursday of each month from September to May.

Chicago Ophthalmological Society

President: Dr. Robert B. Blue, 25 E. Washington St., Chicago.
Secretary-Treasurer: Dr. Thomas D. Allen, 122 S. Michigan Ave., Chicago.
Place: Medinah Michigan Avenue Club, 505 N. Michigan Ave. Time: Third Monday of each month from October to May.

Cincinnati Ophthalmic Club

Chairman: Each member, in rotation.
Secretary-Treasurer: Dr. E. R. Thomas, 819 Carew Tower, Cincinnati
Place: Holmes Memorial Library, Cincinnati General Hospital. Time: 8:15 p. m., third Monday of each month except June, July and August.

Cleveland Academy of Medicine, Section of Ophthalmology and Otolaryngology

Chairman: Dr. A. D. Ruedemann, 2020 E. 93d St., Cleveland.
Secretary: Dr. Fred W. Dixon, 1029 Rose Bldg., Cleveland.
Place: Winton Hotel. Time: Fourth Friday of each month.

Cleveland Ophthalmological Club

Chairman: Dr. A. B. Bruner, 629 Euclid Ave., Cleveland.
Secretary: Dr. M. W. Jacoby, Hanna Bldg., Cleveland.

COLLEGE OF PHYSICIANS, PHILADELPHIA, SECTION ON OPHTHALMOLOGY

Chairman: Dr. John Milton Griscom, 2213 Walnut St., Philadelphia.
Clerk: Dr. Alexander G. Fewell, 1924 Pine St., Philadelphia.
Time: Third Thursday of every month from October to April, inclusive.

COLUMBUS OPHTHALMOLOGICAL AND OTO-LARYNGOLOGICAL SOCIETY

Chairman: Dr. F. W. Thomas, 327 E. State St., Columbus, Ohio.
Secretary-Treasurer: Dr. H. D. Emswiler, 370 E. Town St., Columbus, Ohio.
Place: Athletic Club. Time: First Monday of each month.

DALLAS ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. F. H. Newton, Mercantile Bldg., Dallas, Texas.
Secretary: Dr. Maxwell Thomas, 1719 Pacific Ave., Dallas, Texas.
Place: Dallas Athletic Club. Time: 6:30 p. m., first Tuesday of each month from October to June. The November, January and March meetings are devoted to clinical work.

DES MOINES ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. E. G. Linn, 604 Locust St., Des Moines, Iowa.
Secretary-Treasurer: Dr. Grace Doane, 614 Bankers Trust Bldg., Des Moines, Iowa.
Time: 7:45 p. m., third Monday of every month, September to May.

DETROIT OPHTHALMOLOGICAL CLUB

Chairman: Members rotate alphabetically.
Secretary: Dr. Raymond S. Goux, David Whitney Bldg., Detroit.
Time: 6:30 p. m., first Wednesday of each month.

EASTERN NEW YORK EYE, EAR, NOSE AND THROAT ASSOCIATION

President: Dr. A. W. Greene, 148 Barrett St., Schenectady.
Secretary-Treasurer: Dr. Joseph L. Holohan, 317 State St., Albany.
Time: Third Wednesday in October, November, March, April, May and June.

FORT WORTH EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. T. L. Goodman, 602 W. 10th St., Fort Worth, Texas.
Secretary-Treasurer: Dr. Van D. Rathgeber, 1012 Medical Arts Bldg., Fort Worth.
Place: Medical Hall, Medical Arts Bldg. Time: 7:30 p. m., first Friday of each month except July and August.

GRAND RAPIDS EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. John H. McRae, 26 Sheldon Ave., S. E., Grand Rapids, Mich.
Secretary-Treasurer: Dr. Robert G. Laird, 307 Metz Bldg., Grand Rapids, Mich.
Place: Various local hospitals. Time: Third Thursday of alternating months. September to May.

HOUSTON ACADEMY OF MEDICINE, EYE, EAR, NOSE AND THROAT SECTION

President: Dr. R. M. Hargrove, 1202 Esperson Bldg., Houston, Texas.
Secretary: Dr. J. C. Dickson, 1617 Medical Arts Bldg., Houston, Texas.
Place: Medical Arts Bldg., Harris County Medical Society Rooms. Time: 8 p. m., second Thursday of each month from September to June.

INDIANAPOLIS OPHTHALMOLOGICAL AND OTOLARYNGOLOGICAL SOCIETY

President: Dr. J. C. Daniel, 23 E. Ohio St., Indianapolis.
Secretary: Dr. Kenneth L. Craft, 23 E. Ohio St., Indianapolis.
Place: University Club. Time: 6:30 p. m., second Thursday of each month from October to May.

KANSAS CITY SOCIETY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. H. B. Davis, 1101 Grand Ave., Kansas City, Mo.
Secretary: Dr. Byron Black, Professional Bldg., Kansas City, Mo.
Time: Third Thursday of each month from September to May. The November, January and March meetings are devoted to clinical work.

LONG BEACH EYE, EAR, NOSE AND THROAT SOCIETY

Chairman: Dr. K. C. Brandenburg, 110 Pine Ave., Long Beach, Calif.
Secretary-Treasurer: Dr. Ben K. Parks, 619 Professional Bldg., Long Beach, Calif.
Place: Professional Bldg. Time: Last Wednesday of each month from October to May.

LOS ANGELES SOCIETY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. William A. Boyce, 727 W. 7th St., Los Angeles.
Secretary-Treasurer: Dr. John P. Lordan, 2007 Wilshire Blvd., Los Angeles.
Place: Los Angeles County Medical Association Bldg., 1925 Wilshire Blvd. Time: 6:30 p. m., fourth Monday of each month from September to May, inclusive.

LOUISVILLE EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. J. S. Bumgardner, Heyburn Bldg., Louisville, Ky.
Secretary-Treasurer: Dr. Max Bornstein, Heyburn Bldg., Louisville, Ky.
Place: Brown Hotel. Time: 6:30 p. m., second Thursday of each month from September to May, inclusive.

MEDICAL SOCIETY OF THE DISTRICT OF COLUMBIA, SECTION OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

Chairman: Dr. Arthur M. Zinkham, 815 Connecticut Ave., Washington.
Secretary: Dr. E. J. Cummings, 1835 I St., N. W., Washington.
Place: 1718 M St., N. W. Time: 8 p. m., third Friday of each month from October to April, inclusive.

MEMPHIS SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

Chairman: Each member, in alphabetical order.
Secretary: Dr. R. O. Rychener, 130 Madison Ave., Memphis, Tenn.
Place: Eye Clinic of Memphis Eye, Ear, Nose and Throat Hospital. Time: 8 p. m., second Tuesday of each month.

MILWAUKEE OTO-OPHTHALMIC SOCIETY

President: Dr. Hilmar G. Martin, 231 W. Wisconsin Ave., Milwaukee.
Secretary-Treasurer: Dr. Herbert G. Schmidt, 238 W. Wisconsin Ave., Milwaukee.
Place: University Club. Time: 6 p. m., second Tuesday of each month.

MINNEAPOLIS OPHTHALMOLOGICAL SOCIETY

Chairman: Each member in alphabetical order.
Secretary: Dr. C. W. Rucker, 527 Medical Arts Bldg., Minneapolis.
Place: Hennepin County Medical Society rooms. Time: 6:30 p. m., fourth Monday of each month, October to May, inclusive.

MONTGOMERY COUNTY MEDICAL SOCIETY

Chairman: Dr. W. J. Blackburn, 663 Reibold Bldg., Dayton, O.
Secretary-Treasurer: Dr. F. J. Driscoll, 986 Reibold Bldg., Dayton, O.
Place: Van Cleve Hotel. Time: 6:30 p. m., bimonthly, first Tuesday from October to June, inclusive.

Montreal Ophthalmological Society

President: Dr. Stuart Ramsay, 1496 Mountain St., Montreal, Canada.
Secretary: Dr. J. Rosenbaum, 1396 St. Catherine St., West, Montreal, Canada.
Time: Second Thursday of October, December, February and April.

Nashville Academy of Ophthalmology and Otolaryngology

Chairman: Dr. Kate S. Zerfoss, 119, 7th Ave., N., Nashville, Tenn.
Secretary-Treasurer: Dr. Fowler Hollabaugh, Doctors Bldg., Nashville, Tenn.
Place: St. Thomas Hospital. Time: 8 p. m., third Monday of each month from October to June.

New Orleans Ophthalmological and Otolaryngological Society

President: Dr. R. H. Fisher, Chess and Checker Club, New Orleans.
Secretary-Treasurer: Dr. H. F. Brewster, 837 Gravier St., New Orleans.
Place: Eye, Ear, Nose and Throat Hospital. Time: Third Thursday of each month from October to June.

New York Academy of Medicine, Section of Ophthalmology

Chairman: Dr. John H. Dunnington, 30 W. 59th St., New York.
Secretary: Dr. LaGrand H. Hardy, 30 E. 40th St.,, New York.
Time: 8:30 p. m., third Monday of every month from October to May, inclusive.

Omaha and Council Bluffs Ophthalmological and Oto-Laryngological Society

President: Dr. W. H. Stokes, 107 S. 17th St., Omaha.
Secretary-Treasurer: Dr. Delbert K. Judd, 1020 Medical Arts Bldg., Omaha.
Place: Omaha Club, 20th and Douglas Sts., Omaha. Time: 6 p. m., dinner; 7 p. m., program; third Wednesday of each month from October to May.

Passaic-Bergen Ophthalmological Club

President: Dr. E. C. Reynolds, 657 Main Ave., Passaic, N. J.
Secretary-Treasurer: Dr. T. A. Sanfacon, 80 Park Ave., Paterson, N. J.
Place: Paterson Eye and Ear Infirmary. Time: 9 p. m., last Friday of every month, except June, July and August.

Philadelphia County Medical Society, Eye Section

Chairman: Dr. Charles R. Heed, 1205 Spruce St., Philadelphia.
Secretary: Dr. Sidney L. Olsho, 235 S. 15th St., Philadelphia.
Time: First Thursday of each month from October to May.

Pittsburgh Ophthalmological Society

President: Dr. Glendon E. Curry, Westinghouse Bldg., Pittsburgh.
Secretary: Dr. George H. Shuman, Park Bldg., Pittsburgh.
Place: Pittsburgh Academy of Medicine Bldg. Time: Fourth Monday of each month, except June, July, August and September.

Pittsburgh Slit-Lamp Society

President: Dr. W. W. Blair, 121 University Pl., Pittsburgh.
Secretary: Dr. George H. Shuman, Park Bldg., Pittsburgh.
Place: Falk Clinic. Time: 4 p. m., second Friday of every month, except June, July, August and September.

Richmond Ophthalmological and Oto-Laryngological Society

President: Dr. Robert H. Courtney, Professional Bldg., Richmond, Va.
Secretary: Dr. Richard W. Vaughan, Medical Arts Bldg., Richmond, Va.
Place: Westmoreland Club. Time: 6 p. m., second Monday of each month from October to May.

Rochester Eye, Ear, Nose and Throat Society

President: Dr. R. E. Elliott, 78 S. Fitzhugh St., Rochester, N. Y.
Secretary-Treasurer: Dr. Raphael Farber, 280 Monroe Ave., Rochester, N. Y.
Place: Rochester Medical Association, 113 Prince St. Time: 8 p. m., third Monday of each month from October to May.

St. Louis Ophthalmic Society

President: Dr. Meyer Wiener, 308 N. 6th St., St. Louis.
Secretary: Dr. W. M. James, Metropolitan Bldg., St. Louis.
Place: Oscar Johnson Institute. Time: Clinical meeting 5:30 p. m., dinner and scientific meeting 6:30 p. m., fourth Friday of each month from October to April, inclusive, except December.

San Antonio Ophthalmolo-Oto-Laryngological Society

President: Dr. William D. Gill, 323 Medical Arts Bldg., San Antonio, Texas.
Secretary-Treasurer: Dr. Frank Steed, Nix Professional Bldg., San Antonio, Texas.
Place: Bexar County Medical Library. Time: 8 p. m., first Tuesday of each month from October to May.

San Francisco County Medical Society, Section on Eye, Ear, Nose and Throat

Chairman: Dr. Frank H. Rodin, 490 Post St., San Francisco.
Secretary: Dr. Louis F. Morrison, 490 Post St., San Francisco.
Place: Society's Building, 2180 Washington St., San Francisco.
Time: Fourth Tuesday of every month except May, June, July and December.

Shreveport Eye, Ear, Nose and Throat Society

President: Dr. John T. Crebbin, 624 Travis St., Shreveport, La.
Secretary-Treasurer: Dr. J. A. Wilkinson, Medical Arts Bldg., Shreveport, La.
Place: 1240 Texas Ave. Time: 7:30 p. m., first Monday of every month except July, August and September.

Spokane Academy of Ophthalmology and Oto-Laryngology

President: Dr. C. A. Veasey Jr., 407 Riverside Ave., Spokane, Wash.
Secretary: Dr. Philip B. Greene, Old National Bank Bldg., Spokane, Wash.
Place: Paulsen Medical and Dental Library. Time: 8 p. m., fourth Tuesday of each month except June, July and August.

Syracuse Eye, Ear, Nose and Throat Society

President: Dr. W. J. Werfelman Jr., 725 State Tower Bldg., Syracuse, N. Y.
Secretary-Treasurer: Dr. I. Herbert Katz, 212 Medical Arts Bldg., Syracuse, N. Y.
Place: University Club. Time: First Tuesday of each month except June, July and August.

Toronto Academy of Medicine, Section of Ophthalmology

Chairman: Dr. Samuel Mortimer Lyon, 122 Bloor St. W., Toronto.
Secretary: Dr. A. Lloyd Morgan, 86 Bloor St., West, Toronto.
Time: First Monday, November to April.

Washington, D. C., Ophthalmological Society

President: Dr. James M. Greear Jr., 1740 M St., N. W., Washington, D. C.
Secretary-Treasurer: Dr. Ernest Sheppard, 927 17th St., Washington, D. C.
Place: Episcopal Eye, Ear and Throat Hospital. Time: 8 p. m., first Monday in November, January, March and May.

INDEX TO VOLUME 15

The asterisk (*) preceding the page number indicates an original article in the Archives. Subject entries are made for all articles. Author entries are made for original articles and society transactions. Book Reviews, Obituaries and Society Transactions are indexed under these headings in their alphabetical order under the letters B, O and S, respectively.

Abnormalities and Deformities: See also Monsters; Twins; and under names of diseases and organs, as, Eyes, abnormalities; Fingers and Toes, abnormalities; Iris, absence of; Melanosis; Retina, abnormalities; Uvea, anomaly; etc.
bilateral familial microphthalmos associated with congenital macular degeneration, 1144
genesis of atypical ocular coloboma, 554
rare malformations of iris, 324
Accommodation and Refraction: See also Astigmatism; Glasses; Hemeralopia; Myopia; etc.
accommodative effort in corrected ametropia, 563
ametropia and sex, 943
changes in refraction following operation for strabismus, *1020
dark adaptation as clinical test; technic and results, *1004
effect of lack of oxygen on dark adaptation, 1146
factor in production of divergence increase with near vision, 943
functional disturbances of eyes, *589
influence of previous visual stimuli on dark adaptation, 143
instrument for measuring dynamic speed of vision, speed of accommodation and ocular fatigue, *1072
kinescopy, objective and subjective (practical kinescope S), 1142
kinetic velonoscopy, 137
new method of determining when rays from magnifying lens are parallel, convergent or divergent, 364
new ways in study of accommodation; vitreous in accommodating eye, 334
new ways of studying accommodation; elasticity of zonula, 562
numerical tables for accommodative effort in corrected ametropia, 563
optical elements in anisometropia and isometropia, 144
relation between state of adaptation and sensitivity of eye to electric stimuli, 143
study of central and peripheral light and dark adaptations with varying backgrounds, 333
Acetarsone, blindness occurring in 2 patients with dementia paralytica under treatment with acetarsone (stovarsol), 343
Acetylarsan: See under Arsenic
Acetylcholine: See Choline and Choline Derivatives
Acid, Ascorbic: See Vitamins, C
Cevitamic: See Vitamins, C
Actinomycosis, concretions in lacrimal caniculus caused by Actinomyces, 330
Adaptometry: See Accommodation and Refraction
Adenocarcinoma, choroidal metastasis of thyroid tumor, 148
Adie Syndrome: See Reflex, pupillary
Adler, F. H.: Mechanism of fovea, 782
Adolescence, chronic tuberculous juvenile meningo-encephalitis with pubertas praecox, choked disk and bitemporal hemianopia, 1143
Adrenal Preparations, subconjunctival iron deposits after adrenin injections, 129
Adrenals, ascorbic acid content of retina and adrenals of animals, 126
Adrenin: See Adrenal Preparations
Air, investigation of visual field at low oxygen and atmospheric pressures, 761
Allergy: See Anaphylaxis and Allergy
Amaurosis: See Blindness
Amblyopia: See Blindness
Amblyoscope, Worth-Black, mounting for, *898
American Academy of Ophthalmology and Otolaryngology, meeting, 544
scientific exhibit, 921
American Board of Ophthalmology, examinations, 320
College of Surgeons, meeting, 544
Ametropia: See Accommodation and Refraction
Anaphylaxis and Allergy, allergic tests in connection with external ocular conditions, 1161
allergy of eye, 1130
allergy theory of sympathetic ophthalmia, 571
noninfectious conjunctival allergies considered in regard to general allergy, 739
rôle of allergy in certain conjunctivitides, 322
studies on vascularization of cornea; histologic changes accompanying corneal sensitiveness, 327
Anemia, pernicious, bilateral subhyaloid hemorrhages and retinal hemorrhages in, 1163
subacute combined degeneration of spinal cord in pernicious anemia with retrobulbar neuritis, 575
Aneurysm of posterior communicating artery; ligation of internal carotid artery; third nerve palsy, 1164
Angioid Streaks: See under Retina
Angioma, angiomata retinae (Hippel's disease), 1164
of eyelid, treatment by sclerosing injections, 764
Angioneurosis: See Vasomotor System, diseases
Angiosarcoma of choroid, 348
Angioscotoma: See Scotoma
Anglometer, precision, *703
Aniridia: See Iris, absence of
Anisometropia: See Accommodation and Refraction
Anisophoria: See Heterophoria
Anomalies: See Abnormalities and Deformities; and under names of organs and regions
Anophthalmos: See Eyes, absence of
Anthrax, malignant anthrax edema, 1141
Aphakia: See Lens, Crystalline
Apparatus: See also Instruments
binocular vision in everyday life with description of binocular gage, 152
device for detection of malingerers, *520
diathermic diaphanoscope, 357
for examination of eye, demonstration of, 353
kinescopy, objective and subjective (practical kinescope S), 1142
mounting for Worth-Black amblyoscope, *898
new method of determining when rays from magnifying lens [loupe] are parallel, convergent or divergent, 364
pyrometric controller with variable zero for ocular diathermy, presentation of, 356
Applebaum, A.: Keratoconus, *900
Aqueous Humor, application of microquinhydrone electrode to determination of p_H of aqueous humor of rachitic and normal rats, 1130
chlorine content of aqueous, vitreous and serum, 126
its generation, functions and circulation, *40
studies in protein content of, 739
Arachnodactylia: See Fingers and Toes, abnormalities
Argyll Robertson Pupil: See under Pupils
Arruga, H.: Prognosis in surgical treatment of retinal detachment, 356
Arsenic, blindness following use of acetylarsan (p-oxy-acetyl-amino-phenylarsinate of diethylamine), 344
optic neuritis in course of treatment by injections of pentavalent arsenicals, 335
Arsphenamine, neoarsphenamine in treatment of nonsyphilitic inflammations of uveal tract, *826
Arteries: See also Aneurysm; Arteriosclerosis; Blood pressure; Vasomotor System; etc.
carotid; blood pressure in retinal vessels in case of pulsating exophthalmos, 751
carotid; favorable influence of double carotid sympathectomy in case of atrophic chorioretinitis, 1154

Arteries—Continued
periarterial sympathectomy (Leriche-Doppler) for treatment of atrophies of retina and optic nerve, 565
Retinal: See Retina, blood supply
third nerve palsy; aneurysm of posterior communicating artery; ligation of internal carotid artery, 1164
Arteriosclerosis; light sense in arteriosclerosis and malaria, 744
Ascorbic Acid: See Vitamins, C
Asphyxia, experimental, cataract due to, 330
Astigmatism following operation for cataract, study of, 943
new and practical charts and lighting for testing visual acuity and locating astigmatic axis, 772
problem of crystalline lens, *859
Atmosphere: See Air
Atrophy: See under names of organs and regions
Autohemotherapy: See Hemotherapy
Aviation, measurement of speed of adjustment of eye to near and far vision: further study, *423
Avitaminosis: See under Vitamins
Avižonis, P.: Personal experience with treatment of retinal detachment by means of diathermocoagulation, 356

Bacteria, Granulosis: See Trachoma
Bacteriophage, effect of bacterial lysate on staphylococcic keratoconjunctivitis in rabbits, *47
Badeaux, F.: Herpes ophthalmicus; radiotherapy in herpes zoster ophthalmicus and herpetic keratitis, 953
Badot, J.: Statistics on injuries to eyes in coal industry, 358
Barkan, O.: Structure and functions of angle of anterior chamber and Schlemm's canal, *101
Beach, S. J.: Intracapsular extraction of cataract in average practice: report of 100 cases in which Verhoeff's method was used, *95
Beetles, acute ocular disease caused by, 939
Bellows, J.: Biochemistry of lens; cevitamic acid content of blood and urine of subjects with senile cataract, *78
Bender, M. B.: Nerve supply to orbicularis muscle and physiology of movements of upper eyelid with reference to pseudo-Graefe phenomenon, *21
Benham, L. R.: Allergic tests in connection with external ocular conditions, 1161
Phlyctenular keratitis, 1120
Benzyl Cinnamic Ether: See under Cornea
Biastigmatism: See Astigmatism
Biedl-Laurence Syndrome: See Laurence-Biedl syndrome
Bielschowsky, A.: Functional disturbances of eyes, *589
Birth Injuries: See New-Born Infants
Blake, E. M.: Twinning and ocular pathology with report of bilateral macular coloboma in monozygotic twins, *1050
Blennorrhea: See Conjunctivitis
Blepharoplasty: See under Eyelids
Blindness: See also Ophthalmia neonatorum; Vision; etc.
aid to needy blind, 1121
chief preventable blinding diseases of childhood, 742
Color: See Color Blindness
complete return of sight in amblyopic eye, 563
eye diseases and their causes in land of Canaan, 936
following use of acetylarsan (p-oxy-acetyl-amino-phenylarsinate of diethylamine), 344
International Association for Prevention of, 1120
National Society for Prevention of, 1119
Night: See Hemeralopia
nyctalopia caused by tobacco amblyopia in chauffeurs, 764
occurring in 2 patients with dementia paralytica under treatment with acetarsone (stovarsol), 343
Blood, biochemistry of lens; cevitamic acid content of blood and urine of subjects with senile cataract, *78
Blood—Continued
chlorine content of aqueous, vitreous and serum, 126
Diseases: See Anemia
fats and lipoids; blood lipoids in lipaemia retinalis, *86
physical chemical constants in relation to senile cataract, 126
physicochemical constants in glaucoma, 1137
pressure, determination; relation between vascular system and diseases of eye, 931
pressure, high; hypertensive fundus oculi after resection of splanchnic sympathetic nerves; preliminary report, *840
pressure, high; aspects of conjunctival circulation in general arterial hypertension, 130
pressure in retinal vessels in case of pulsating exophthalmos, 751
pressure, low; chronic glaucoma and arterial hypotension therapy, 135
pressure, low systemic pressure and its relation to intra-ocular tension and to diseases of optic nerve, 360
pressure, obscure influence on progress of optic nerve disease, 757
some results of subungual capillaroscopy in ophthalmologic practice, 362
transfusion; hemophiliac with bleeding for 2 weeks after iridectomy; failure of classic medical coagulants; cure immediately after blood transfusion, 556
Bones, fragility; syndrome of blue scleras, 929
growth; craniofacial dysostosis (Crouzon's disease), 1143

Book Reviews:

Bericht über die Tätigkeit der Univ. Augenklinik No. 1, Budapest, 1904-1935; E. von Grósz, 578
Biological or Artery Flaps of Face; J. F. S. Esser, 153
Cosmic Way to True Civilization Through Parenthood; G. H. Donahue, 579
Extraction capsulo-lenticulaire de la cataracte; R. De Saint-Martin, 367
Ninth Annual Report (1934) of Giza Memorial Ophthalmic Laboratory, Cairo, 1166
Outlines of Ophthalmology; D. E. Rolf, 791
Primären Tumoren des Sehnerven und der Sehnervenkreuzung; A. Lundberg, 366
Radium Treatment of Skin Diseases, New Growths, Diseases of Eyes and Tonsils; F. H. Williams, 965
Störungen des Lichtreflexes der Pupille bei den luetischen Erkrankungen des Zentralnervensystems; Beiträge zur Frühdiagnostik der Lues nervosa; O. Löwenstein, 365
Tabulae Pseudo-Isochromaticae; C. G. Bostrom, 792
Twenty-Second Annual Report of Ophthalmic Hospitals Section for 1934, 792

Brain, W. R.: Meningioma of optic nerve within orbit, 1162
Third nerve palsy; aneurysm of posterior communicating artery; ligation of internal carotid artery, 1164
Third nerve palsy following dental extraction, 1164

Brain: See also Lenticular Nucleus; Meninges; Nervous System; etc.
concussion, disturbance of fusion following, report of cases, 749
concussion, ocular syndrome following, report of cases, 750
echinococcus cyst and ocular complications, report of 2 cases, 941
homonymous hemianopia; practical points in interpretation with report of 49 cases in which lesion in brain was verified, *604
pupillary light reflex after lesions of posterior commissure in cat, 942
pupillary reactions in combined lesions of posterior commissure and of pupillodilator tracts; contribution to pathogenesis of Argyll Robertson pupil, *195
vasomotor system in retinal and cerebral vascular lesions, 144

British Medical Association, Section on Ophthalmology, annual meeting, 921

Brock, S.: Hemangioblastomatosis of retina and central nervous system with visceral lesions (von Hippel-Lindau disease), 957

Burch, F. E.: Association of ectopia lentis with arachnodactyly, *645
Burns, early surgical treatment of caustic burns of eyeball; experimental and pathologic-anatomic considerations, 1144

Cairns, H.: Meningioma of optic nerve within orbit, 1162
Camera, miniature, photography of eye with, 1142
Cancer: See Epithelioma; Sarcoma; etc.; and under names of special structures
Capillaries, lesions of macula of capillary origin, 336
some aspects of conjunctival circulation in general arterial hypertension, 130
Carbaminoylcholine: See Choline and Choline Derivatives
Cardell, J. D.: Angiosarcoma of choroid, 348
Cardiovascular diseases, retinal angioscopy and early diagnosis of, 354
Carotene, influence on chemical processes in eye, 127
Cataract, biochemistry of lens; cevitamic acid content of blood and urine of subjects with senile cataract, *78
biochemistry of lens; mineral metabolism in normal and in cataractous lens, *217
congenital, anomaly of ciliary body associated with, 926
detachment following simple extraction of, 576
di-nitrophenol poisoning with cataract, 345
due to di-nitrophenol, *116, 746
due to experimental asphyxia, 330
electric, 1140
extraction, epithelial downgrowth into anterior chamber following extraction; arrest by radium treatment, *270
extraction, intracapsular, analysis of 1,343 extractions by 48 operators following Verhoeff method, 784
extraction, intracapsular, and some details of its technic, 560
extraction, intracapsular, in average practice; report of 100 cases in which Verhoeff's method was used, *95
extraction; iridocorneal angle in operations for cataract, 748
extraction, results 5 years and more after operation, 784
extraction; study of astigmatism following operation for, 943
following use of di-nitrophenol, 330, 747
hereditary, especially cataracta centralis pulvurulenta, 748
hereditary, senile and presenile types, *222
in childhood with simultaneous occurrence of poikiloderma atrophicans vasculare; familial occurrence (Rothmund's disease) in Switzerland, 559
late development following use of di-nitrophenol about year before, 747
operations, sutures for lid control in, 937
pathogenesis, further experimental data, 328
pathogenesis, new experimental data, 327
pathogenesis of von Szily's ring-shaped cataract, report of case, 938
phospholipid content of cataractous human lenses, 1140
physicochemical studies on normal and pathologic lens, 1131
planar capsular, clinical and histologic studies, report of cases, 749
rapidly developing cataracts following use of di-nitrophenol, 330, 346
relation between parathyroid glands and cataract in young people, 136
senile, physical chemical constants of blood in relation to, 126
traumatic, extraction with forceps, 363
traumatic rosette, 136
with rare form of myotonic dystrophy, 138
Catholysis: See Retina, detachment
Cauterization: See under names of various diseases
Cells, recent cytologic studies of pathologic vitreous, 354
Cerebrum: See Brain
Chalcosis: See Copper
Charles, J. W.: Lipodystrophia progressiva with ocular complications, 773
Chlorine content of aqueous, vitreous and serum, 126
Chloro-Ethylene, toxic action of trichlorethylene on eye, report of case, 765
Choked Disk: See Neuritis, optic
Cholesterol crystals in lacrimal sac, 1139
Choline and Choline Derivatives, effect of doryl in treatment of glaucoma, 1138
further experiments on active principles in ocular tissues, 740
Chomé-Bercioux, N.: Retinal detachment and postoperative hemorrhage, 355
Chorioretinitis: See Retinochoroiditis
Choroid, angiosarcoma of, 348
atrophy without night blindness, case of, 569
choroidal metastasis of thyroid tumor, 148
inflammation; choroiditis in cases of lupus erythematosus, 571
sarcoma, circumscribed detachment of retina at ora serrata in 4 cases of, 945
trachoma follicles in choroid and in vitreous of animals after intra-ocular inoculation with trachomatous material, 758
tuberculosis, associated with generalized miliary tuberculosis, 781
Choroiditis: See Choroid, inflammation
Cicatrix, cicatricial ectropion as result of mucocele of frontal sinus; plastic repair, *994
Ciliary Body: See Iridocyclitis; Uvea
Processes: See under Uvea
Clark, C. P.: Rôle of malaria in control of atrophy of optic nerve due to syphilis; study of 12 cases, *250
Clostridium Welchii, panophthalmitis due to, *1088
Coastal Fever: See Typhus
Coats' Disease: See Retinitis, exudative
Cogan, J.: Bilateral subhyaloid hemorrhages and retinal hemorrhages in patient with severe pernicious anemia, 1163
Rodent ulcer, 1163
Siderosis bulbi; foreign body removed, 576
Cohen, M.: Inflammatory exophthalmos in catarrhal disorders of accessory sinuses, *457
Collins; Treacher Collins Fund, 921
Colloids, rôle of allergy in certain conjunctivitides, 322
Coloboma: See Abnormalities and Deformities; Macula Lutea
Color Blindness, detection with leukoscope of Hering, 128
pseudo-isochromatic test cards of Stilling, Nagel and Ishihara, 128
Color Perception, artificial daylight for testing color sense with Ishihara's charts, 331
binocular integration of hue and brilliance, *443
simultaneous and successive color mixtures, 321
Congresses: See under Societies
Conjunctiva, bulbar, nonpigmented nevus of, 1152
capillary pulsations of, 321
conjunctival circulation in general arterial hypertension, some aspects, 130
considerations of 130 strains of pyogenic staphylococci isolated from chronic conjunctival lesions, 1130
fungi grown from conjunctiva, cornea and lacrimal passages, 329
hemorrhagic lymphangiectasis of, 925
local quinine therapy for some diseases of conjunctiva and cornea, *31
syphilitic conjunctivitis (rare cases of ocular syphilis; conjunctival syphilids), 553
temperature changes in conjunctiva in relation to application of heat and cold to skin, 1132
tuberculosis, primary, *975
Conjunctivitis: See also Ophthalmia
acute and chronic, concentration of lysozyme in tears in, 960
epibulbar subconjunctivitis in epidemic parotitis, 134
etiology of inclusion blennorrhea, 552
inclusion blennorrhea, 1131
inoculation of virus of inclusion blennorrhea into trachomatous eyes, 340
ligneous, 1132
noninfectious conjunctival allergies considered in regard to general allergy, 739
Phlyctenular: See Conjunctiva, tuberculosis
pneumococcic, 3 cases of septicemia following, 925

Conjunctivitis—Continued
pseudomembranous nondiphtheritic, accompanying eruptive and buccopharyngeal lesions, 129
rôle of allergy in certain conjunctivitides, 322
trachoma and paratrachoma, 1151
virus of inclusion conjunctivitis, further observations, *377; correction, 734
Consanguinity: See under Marriage
Contact Glasses: See Glasses
Cooke, C. T.: New electrode for surgical diathermy of retina, *711
Copper, bilateral absorption of intra-ocular copper with chalcosis in 1 eye, 937
Coppez, L.: Improvements in technic of pyrometric diathermocoagulation in treatment of retinal detachment, 358
Cornea, autokeratoplasty of Morax, 751
benzylcinnamic ether in treatment of cicatrices of, 555
bilateral epithelioma of corneoscleral margin, 1151
bilateral epithelioma of limbus in boy of 5, 148
blood-staining, 788
chief preventable blinding diseases of childhood; keratomalacia, 742
conical; keratoconus, *900
cystic degeneration of posterior surface, 556
degeneration, calcareous (?) and fatty, *803
degeneration, familial, histologic observations in case of, 741
degeneration, primary calcareous, 928
diseased, histochemical reaction of, 741
diseases; local quinine therapy for some diseases of conjunctiva and cornea, *31
dystrophy with relapsing attacks of keratitis, 576
familial lattice-shaped degeneration of, 1133
fungi grown from conjunctiva, cornea and lacrimal passages, 329
grafting, knife for, 329
grafting—reparative and optical, 132
hematic disciform infiltration, 133
herpes corneae with reference to its treatment with strong solution of iodine, *225
Inflammation: See Keratitis
innervation of, 1132
ionization with potassium iodide and sodium salicylate and its clearing effects on corneal opacities, 326
keratoplasty, 325
obliteration of pericorneal blood vessels for various types of keratitis, 1157
opacity; white ring in cornea, *112, *309
pathologic lipoid infiltration of cornea and sclera, 134
pigmentation; Wilson's disease (progressive lenticular degeneration) with Kayser-Fleischer ring, 1165
Syphilis: See Keratitis, interstitial
ulcers, infectious, etiology and therapy of, 1134
ulcers; malnutrition in relation to ulceration of cornea in gonorrheal ophthalmia neonatorum, 740
ulcers, rodent, 1163
ulcers, rodent, treatment of, 326
ulcers, trophic, cured by local vitamin therapy, 929
ulcus rodens, etiology of, 929
Vascularization: See Trachoma
venereal disease and corneal traumas and ulcerations, 743
virus of vaccinia and of rabies developed in corneal epithelium, 556
Correction in transcript of article by W. M. Dodge Jr., entitled, "Histopathologic Characteristics of Nutritional Cataract in White Rat," (14: 922 [Dec.] 1935), 320
in transcript of German Ophthalmological Society held Aug. 6 to 8, 1934 (13:914 [May] 1935), 125
Cosgrove, K. W.: Hereditary cataract of senile and presenile types, *222
Coston, T. O.: Primary tumor of optic nerve with report of case, *696
Cowan, A.: Cystlike ectropion uveae, 345
Schematic eye, *312; correction, 545
Cox, R. A.: Congenital head-nodding and nystagmus; report of case, *1032
Cranium, pressure; experimental studies of relation between pressure in retinal veins and intracranial pressure, 333
Crouzon's Disease: See Bones, growth
Cruise, R.: Detachment following simple extraction of cataract, 576
Crystalline Lens: See Lens, Crystalline
Culler, A. M.: Artificial fever therapy in cases of ocular syphilis, *624
Cyclodialysis: See under Glaucoma
Cyclopia: See under Monsters
Cysts: See under Brain; Cornea; Eyelids; Eyes; Iris; Retina; etc.

Dacryoadenitis: See under Lacrimal Organs
Dacryocystitis; Dacryocystorhinostomy; Dacryorhinocystotomy: See under Lacrimal Organs
Dallos, J.: Contact glasses, the "invisible" spectacles, *617
Dana, Leslie Dana Gold Medal to Dr. John M. Wheeler, 1121
Dark Adaptation: See Accommodation and Refraction
Davis, A. E.: Removal of xanthelasma with chromic acid, 959
Davison, C.: Hemangioblastomatosis of retina and central nervous system with visceral lesions (von Hippel-Lindau disease), 957
Deafness, syndrome of blue scleras, 929
Dean, F. W.: Anatomic phorias, *692
Deformities: See Abnormalities and Deformities
Degeneration, fatty, and infiltration of uvea, 571
fatty; pathologic lipoid infiltration of cornea and sclera, 134
of cornea, calcareous (?) and fatty, *803
primary calcareous, of cornea, 928
Dehydrogenation: See Tissue, respiration
Dejean, C.: Syndrome of floor of orbit, 361
Der Brucke, M. G.: Cyclopia, *114
Devic's Disease: See Neuritis, optic
Diabetes Mellitus, blood lipids in lipaemia retinalis, *86
is hypertension instrumental in aiding development of diabetic retinitis? report of cases, 756
slit-lamp examination of alterations of anterior segment of eye and of vitreous in diabetic patients, 341
Diathermy: See also under names of various diseases and organs, i. e., Retina, detachment; etc.
diathermic and galvanic treatment of separated retina, especially of flat type, with specially devised minimal stop and single and multiple platinum micro-electrodes; new magazine containers, 768
presentation of pyrometric controller with variable zero for ocular diathermy, 356
Diathesis, exudative, ocular manifestation in, 557
Diktyoma, advanced stage, report of case, *680
Di-Nitrophenol: See Nitrophenol
Directory of ophthalmologic societies, 154, 368, 580, 794, 966, 1168
Disk, Optic: See Nerves, optic
Dodge, W. M.: Histopathologic characteristics of nutritional cataract in white rat (14: 922 [Dec.] 1935), correction, 320
Doggart, J. H.: Eclamptic detachment of retina, 963
Fuchs' epithelial dystrophy, 350
Dolichostenomelia: See Fingers and Toes, abnormalities
Donders, F. C., letters from Albrecht von Graefe (1852 to 1870), 1138
Doryl: See Choline and Choline Derivatives
Drugs, allergy of eye, 1130
Duggan, W. F.: White ring in cornea, *309
Dunphy, E. B.: Ocular complications of cerebrospinal meningitis, *118
Dupuy-Dutemps, P.: Traumatic paralysis of both nerves of sixth pair, 361
Dyke, C. G.: Hemangioblastomatosis of retina and central nervous system with visceral lesions (von Hippel-Lindau disease), 957
Dysostosis: See Bones, growth
Dystrophy, Fuchs' epithelial dystrophy, 347, 350
muscular; lens changes typical of myotonic dystrophy; report of case, 1156
muscular; rare form of myotonic dystrophy with cataract, 138

Echinococcosis: See under names of various organs, as Brain
Eclampsia; eclamptic detachment of retina, 963
Ectopia Lentis: See under Lens, Crystalline
Ectropion: See under Eyelids
Edema, Malignant: See Anthrax
Electricity; electric cataract, 1140
Electrocoagulation: See Diathermy; and under specific headings, as Retina, detachment; etc.
Electrode for surgical diathermy of retina, *711
Electrolysis: See Retina, detachment
Electrosurgery: See Diathermy; and under specific headings, as Retina, detachment; etc.
Ellett, E. C.: Results of cataract extraction 5 years and more after operation, 784
Elliot Operation: See Glaucoma
Ellison, J.: Case of sclerosing keratitis, 577
Endothelioma of optic nerve sheaths, 759
Entropion: See under Eyelids
Epiphora: See Lacrimal Organs
Epithelioma, bilateral, of corneoscleral margin, 1151
bilateral, of limbus in boy of 5, 148
Epithelium, epithelial downgrowth into anterior chamber following cataract extraction; arrest by radium treatment, *270
Esophoria: See Strabismus
Exophthalmos: See also Goiter, exophthalmic
from orbital tumor, 939
inflammatory, in catarrhal disorders of accessory sinuses, *457
intermittent, rare form with atrophy of optic nerve, 940
pulsating, blood pressure in retinal vessels in case of, 751
unilateral, 939
Eyelids, cicatricial ectropion as result of mucocele of frontal sinus; plastic repair, *994
cystlike ectropion uveae, 345
entropion originating at external angle, 137
glandular tumor of lower lid, 947
malignant anthrax edema, 1141
nerve supply to orbicularis muscle and physiology of movements of upper eyelid with reference to pseudo-Graefe phenomenon, *21
ptosis, Trainor operation for, 954
sutures for lid control in cataract operations, 937
symblepharon from pemphigus corrected with mucous membrane graft, 789
treatment of angioma by sclerosing injections, 764
Eyes: See also Abnormalities; Foreign Bodies; Tension; Vision; and under names of special structures and diseases
absence of; case of unilateral anophthalmos with cyst, 554
absence of; 3 cases of anophthalmia, clinical observation, 359
Accommodation and Refraction: See Accommodation and Refraction
active principles in ocular tissues, further experiments, 740
acute ocular disease caused by beetles, 939
allergic tests in connection with external ocular conditions, 1161
Anomalies: See Abnormalities and Deformities, and under names of special structures of the eye and diseases
biochemistry of, *522
Cysts: See also under Cornea; Eyelids; Iris; Retina; etc.
cysts, free, floating in anterior chamber, report of case, *822
Diseases: See also Iridocyclitis; Glaucoma; Ophthalmia; Trachoma; etc.
diseases, blindness and their causes in land of Canaan, 936
diseases; comparative diagnostic value of changes in eye in congenital syphilis of early childhood, 932
diseases; ocular disorders associated with wisdom tooth, 328
diseases; ocular manifestation in exudative diathesis, 557
diseases; relation between vascular system and diseases of eye, 931
epithelial downgrowth into anterior chamber following cataract extraction; arrest by radium treatment, *270
Examination: See also Accommodation and Refraction; Eyes, diseases; etc.
Eyes—Continued
examination; computation of axial length of eye, 332
examination, demonstration of apparatus for, 353
examination; gonioscopic findings after Elliot operation, 933
examination, slit-lamp, of alterations of anterior segment of eye and of vitreous in diabetic patients, 341
familial neurofibromatosis, 760
functional disturbances of, *589
hemorrhage; hemophiliac with bleeding for 2 weeks after iridectomy; failure of classic medical coagulants; cure immediately after blood transfusion, 556
influence of carotene on chemical processes in eye, 127
influence of testicular extract on penetration of drugs into eye, later investigations, 753
injuries; ocular pathology of new-born, 1135
injuries, statistics in coal industry, 358
lipodystrophia progressiva with ocular complications, 773
microscopic observations in 2 eyes in which retinal detachment had been treated by diathermy, 1157
minimal quantity of ultraviolet and of infrared rays which will cause damage to eye, 1134
movements; torsion associated with near vision, 139
Muscles: See also Hyperphoria; Paralysis; Strabismus
muscles; histology of extra-ocular muscles, *847
muscles; is ocular proprioceptive sense concerned in vision? *1037
muscles; myectomy of left inferior oblique muscle for ocular torticollis, 574, 575
muscles; progressive external ophthalmoplegia in case of myopathy, 574
ocular complications and symptoms of "fièvre exanthématique," 353
ocular complications of cerebral meningitis, *118
ocular dominance, its independence of retinal events, *890
Paralysis: See Paralysis
parasites; review of literature and report of case of ophthalmomyiasis interna posterior, 1153
pathology and twinning with report of bilateral macular coloboma in monozygotic twins, *1050
pathology; subconjunctival iron deposits after adrenin injections, 129
Physiology: See also Vision, physiology
physiology; relation between state of adaptation and sensitivity of eye to electric stimuli, 143
Pigmentation: See Cornea, pigmentation
Sarcoma: See Sarcoma
schematic, *312; correction, 545
significance of reptilian "spectacle," 554
structure and functions of angle of anterior chamber and Schlemm's canal, *101
subungual capillaroscopy in ophthalmologic practice, 362
Surgery: See also under names of diseases and special structures of the eye
surgery; principles of modern surgery in ophthalmology, 140
Tension: See Glaucoma; Tension
toxic action of trichlorethylene, report of case, 765
Tuberculosis: See Tuberculosis
tumors; mechanics of retinal detachment in cases of intra-ocular tumor, 338

Fatigue, instrument for measuring dynamic speed of vision, speed of accommodation and ocular fatigue, *1072
Feeblemindedness, relation between refraction and development of brain, 144
Feldman, J. B.: Dark adaptation as clinical test; technic and results, *1004
Review of infra-red photography with reference to its value in ophthalmology, *435
Ferree, C. E.: Instrument for measuring dynamic speed of vision, speed of accommodation and ocular fatigue, *1072
Fever, Coastal: See Typhus
therapy, artificial, in cases of ocular syphilis, *624

Fibroblastoma, syndrome of meningeal fibroblastoma arising from lesser wing of sphenoid bone, *163
Fingers and Toes, abnormalities: arachnodactylia and dislocated lens, 1165
abnormalities; association of ectopia lentis with arachnodactyly, *645
Fistula at limbus (scleromalacia perforans), 325
Folger, H. P.: Uveoparotitis (Heerfordt); report of case, *1098
Forceps: See Instruments
Foreign Bodies, bilateral absorption of intraocular copper with chalcosis in 1 eye, 937
new forceps for removal of lead shot from vitreous, *308
removed; siderosis bulbi, 576
Foster, J.: Vitamins in ophthalmology, 1160
Fragilitas Ossium: See Bones, fragility
Fralick, F. B.: Hypertensive fundus oculi after resection of splanchnic sympathetic nerves; preliminary report, *840
Friedenwald, J. S.: Diagnosis and treatment of anisophoria, *283
Fritz, A.: Physiopathology of retinitis, 353
Frontal sinus, mucocele, cicatricial ectropion as result of; plastic repair, *994
Fruchon, G.: Spontaneous ocular nystagmus and nystagmus elicited by certain procedures involving globe, 361
Fry, G. A.: Binocular integration of hue and brilliance, *443
Fry, W. E.: Vitreous detachment, anterior dialysis and presence of tumor-like mass over optic nerve, 782
Fundus Oculi: See under Retina
Fungi grown from conjunctiva, cornea and lacrimal passages, 329

Gallardo, E.: Concentration of lysozyme in tears in acute and chronic conjunctivitis, 960
Gallois, J.: Note on medical problem of idiopathic detachment of retina, 355
Results of treating glaucomatous states with new calcium-magnesium compound, 360
Retinal angioscopy and early diagnosis of cardiovascular disease, 354
Gas, mustard, keratitis caused by, 1165
Gesell, A.: Twinning and ocular pathology with report of bilateral macular coloboma in monozygotic twins, *1050
Giroux, R.: Retinal angioscopy and early diagnosis of cardiovascular disease, 354
Glasses: See also Accommodation and Refraction
aclastic, experience with, 329
contact, experiences with, 1146
contact, the "invisible" spectacle, *617
rising front bifocals, 143
Glaucoma: See also Tension
anatomic changes after cyclodialysis, *411
and vitreous body, 558
chronic, and arterial hypotension therapy, 135
gonioscopic findings after Elliot operation, 933
infantile, 134
late results in operations for, 936
pathogenesis, without increased pressure, 1138
physicochemical constants of blood in, 1137
primary, treatment with amyl nitrite, 936
results of treating glaucomatous states with new calcium-magnesium compound, 360
shadows of calcareous deposits seen in roentgenograms of area of chiasm in cases complicated with glaucoma, 745
some points in connection with sclerocorneal trephining, 558
therapy: experiences with glaucosan, 342
transient fluctuations in scotoma of, 1137
treatment, effect of doryl in, 1138
with microphakia and spherophakia, 134
with reference to medical aspects and early diagnosis, 934
Glaucosan: See Glaucoma, therapy
Glioma, primary tumors of optic nerve, 568
tumor of optic nerve; report of case, *686
Goiter: See also Thyroid
exophthalmic; progressive exophthalmos in thyroid disease, 140
Gonin's Operation: See Retina, detachment
Gonioscopy: See Eyes, examination
Gonococci, iritis and gono-reaction, 948
Gono-Reaction: See Gonococci
Gordon, B. L.: Problem of crystalline lens, *859
Gradle, H. S.: Effect of mydriatics on intraocular tension, 779
von Graefe, Albrecht, letters to F. C. Donders (1852 to 1870), 1138
Graefe Sign: See under Eyelids
Green, J.: Bullous keratitis; rational therapy, 776
Greene, L. S.: William Holland Wilmer, 1122
Greenwood, A.: Analysis of 1,343 intracapsular cataract extractions by 48 operators following Verhoeff method, 784
Groff, R. A.: Syndrome of meningeal fibroblastoma arising from lesser wing of sphenoid bone, *163
Grossman, H. P.: Analysis of 1,343 intracapsular cataract extractions by 48 operators following Verhoeff method, 784
Guarnieri Bodies: See Smallpox, vaccination
Guillot, P.: Retinal tears without detachment, 355
Guist Operation: See Retina, detachment
Gundersen, T.: Herpes corneae with reference to its treatment with strong solution of iodine, *225
Obliteration of pericorneal blood vessels for various types of keratitis, 1157

Hair, lesions of macula, combined with hair anomaly, in 2 brothers, 146
Hamburger, R.: Phlyctenular keratitis, 1120
Head, congenital head-nodding and nystagmus; report of case, *1032
Heerfordt's Disease: See Uveoparotid Fever
Hemangioblastoma; hemangioblastomatosis of retina and central nervous system with visceral lesions (von Hippel-Lindau disease), 957
Hemeralopia, nyctalopia caused by tobacco amblyopia in chauffeurs, 764
Hemianopia, chronic tuberculous juvenile meningo-encephalitis with pubertas praecox, choked disk and bitemporal hemianopia, 1143
homonymous, practical points in interpretation with report of 49 cases in which lesion in brain was verified, *604
Hemophilia, hemophiliac with bleeding for 2 weeks after iridectomy; failure of classic medical coagulants; cure immediately after blood transfusion, 556
Hemotherapy, autohematotherapy in anterior chamber in tuberculous iridocyclitis, 573
Herbert's Pits: See Trachoma
Heredity, hereditary diseases; chief preventable blinding diseases of childhood, 744
Herpes corneae with reference to its treatment with strong solution of iodine, *225
ophthalmicus and herpetic keratitis, radiotherapy in, 953
ophthalmicus, Argyll Robertson sign persisting 3 years after, 754
zoster ophthalmicus, etiology of, 561
Heterochromia: See under Iris
Heterophoria: See also Strabismus
diagnosis and treatment of anisophoria, *283
functional disturbances of eyes, *589
Hine, M. L.: Excision of palpebral portion of left lacrimal gland, 575
Intra-ocular tumor, 575
Myectomy of left inferior oblique muscle, 574
Myectomy of left inferior oblique muscle for ocular torticollis, 575
Reattachment of detached right retina after extensive operation to seal up 7 holes, 574
Subacute combined degeneration of spinal cord in pernicious anemia with retrobulbar neuritis, 575
von Hippel's Disease: See Retina, tumors
Hollande Reaction: See under Tuberculosis
Holloway, T. B.: Two cases of blood-staining of cornea, 788
Vitreous detachment, anterior dialysis and presence of tumor-like mass over optic nerve, 782
Horner, W. D.: Treatment of iris bombé by iridectomia ab externo; report of cases, *70
Hospital, Royal London Ophthalmic Hospital; visit to King George V extension, *185
Howard, W. H.: New keratoscope, *709
Hunt, G. A.: Mounting for Worth-Black amblyoscope, *898
Hyaline bodies on disks, 145
Hyaloid Canal: See under Vitreous Humor

Hydrogen Ion Concentration, action of p_H of medium on state of swelling of vitreous body, 1153
application of microquinhydrone electrode to determination of p_H of aqueous humor of rachitic and normal rats, 1130
Hyperopia, relation between refraction and development of brain, 144
Hyperphoria associated with overaction of inferior oblique muscle; treatment by recession of origin of muscle, 150
Hyperpyrexia: See Fever
Artificial: See Diathermy; and under names of various diseases
Hypertension: See Blood pressure, high
Ocular: See Tension
Hyperthyroidism: See Goiter, exophthalmic
Hypertrophia: See Hyperphoria
Hypophysis: See Pituitary Body
Hypopyon: See Cornea, ulcers; Keratitis
Hypotension: See Blood pressure, low

Idiocy, amaurotic; histopathology of eyeground changes in Niemann-Pick lipoidosis, 1135
Iles, A. E.: Congenital retinal band in child, 577
Illumination: See Lighting
Industrial Diseases, statistics on injuries to eyes in coal industry, 358
Inflammation, Ocular: See Ophthalmia; and under special structures of eyes
Infra-Red Light, dehydrogenative processes in lens after infra-red irradiation, 559
minimal quantity of ultraviolet and of infra-red rays which will cause damage to eye, 1134
Infra-Red Photography: See Photography
Instruments: See also Apparatus
electrode for surgical diathermy of retina, *711
for measuring dynamic speed of vision, speed of accommodation and ocular fatigue, *1072
forceps for removal of lead shot from vitreous, *308
keratoscope, *709
knife for corneal grafting, 329
needle-holder for ophthalmic and other delicate surgery, *111
precision angiometer, *703
special device for localization and treatment of retinal tear with galvanic current, *1094
International Ophthalmological Congress, meeting, 125
Intra-Ocular Tension: See Tension
Iridectomy: See under Cataract; Glaucoma; Iris
Iridencleisis: See Glaucoma
Iridocyclitis, 1153
new growth of iris in iridocorneal angle, 340
tuberculous, experience in autohematotherapy in anterior chamber in, 573
Iridodialysis: See under Iris
Iris: See also Pupils
absence of; aniridia, report of 3 cases in 1 family, 956
bombé, treatment by iridectomia ab externo; report of cases, *70
ciliary margin of dilator muscle of pupil with reference to some melanomas of iris of epithelial origin, *985
cyst, clinical and histologic contribution, 152
cyst, multilocular, 345
hemophiliac with bleeding for 2 weeks after iridectomy; failure of classic medical coagulants; cure immediately after blood transfusion, 556
inflammation; iritis and gono-reaction, 948
infra-red photography of eye; iris pigment, 137
malformations, rare, 324
new growth in iridocorneal angle, 340
nonsurgical reattachment in case of traumatic iridodialysis, 760
occurrence of ciliary processes on, 739
operative treatment of traumatic iridodialysis, 948
spontaneous dialysis caused by sudden strong flash of light, 2 cases, 949
Tuberculosis: See Iridocyclitis, tuberculous
Iritis: See Iris, inflammation
Irvine, S. R.: Histology of extra-ocular muscles, *847
Is ocular proprioceptive sense concerned in vision? *1037

Ishihara Test: See Color Blindness; Color Perception
Isometropia: See Accommodation and Refraction

Jacobson Solution (Benzyl Cinnamic Ester): See under Cornea
Jayle, G. E.: Ocular complications and symptoms of "fièvre exanthématique," 353
Johnson, T. H.: Homonymous hemianopia; practical points in interpretation with report of 49 cases in which lesion in brain was verified, *604

Kayser-Fleischer Ring: See Cornea, pigmentation
Kennedy Syndrome: See Neuritis, optic
Keratitis: See also Keratoconjunctivitis
Band: See Cornea, opacity
bullous, rational therapy, 776
caused by mustard gas, 1165
corneal dystrophy with relapsing attacks of keratitis, 576
interstitial, experimental, 328
interstitial; therapy-resistant syphilis, especially parenchymatous keratitis and its treatment with quinine, 1133
local quinine therapy for some diseases of conjunctiva and cornea, *31
nummularis Dimmer, 741
obliteration of pericorneal blood vessels for various types of, 1157
phlyctenular, discussed at meeting of Ophthalmological Society of United Kingdom, 1120
pustuliformis profunda, case of, 928
radiotherapy in herpes zoster ophthalmicus and herpetic keratitis, 953
sclerosing, case of, 577
Ulcerative: See Cornea, ulcers
Keratoconjunctivitis, phlyctenular, so-called, and tuberculous allergy, 555
staphylococcic, effect of bacterial lysate in rabbits, *47
Keratoconus: See Cornea, conical
Keratomalacia: See under Cornea
Keratoplasty: See under Cornea
Keratoscope, new, *709
Kidney, Diseases: See Nephritis
Kiehle, F. A.: Tumor of optic nerve; report of case, *686
Kinescope: See Accommodation and Refraction
King George V Extension of Royal London Ophthalmic Hospital, visit to, *185
Klien, B. A.: Ciliary margin of dilator muscle of pupil with reference to some melanomas of iris of epithelial origin, *985
Kluever, H. C.: Panophthalmitis due to Clostridium Welchii, *1088
Knapp, A.: A. S. Percival, 738
Hermann Wilbrand, 735
Richard Deutschmann, 736
W. Adams Frost, 737
Krause, A. C.: Biochemistry of eye, *522
Krimsky, E.: Transitory choked disk; report of case with 11 year follow-up study, *36
Kronfeld, P. C.: Anatomic changes after cyclodialysis, *411
Krukenberg's Spindle: See Cornea, pigmentation

Labor, unilateral reflex mydriasis in cats during labor and diseases of uterus, 141
Labyrinth, influence of labyrinthine stimuli on visual field, 342
Lacrimal Canal: See Lacrimal Organs
Lacrimal Organs, cholesterol crystals in lacrimal sac, 1139
concretions in lacrimal canaliculus caused by Actinomyces, 330
dacryocystitis of new-born, 559
diseases, importance of x-ray examination in, 135
excision of palpebral portion of left lacrimal gland, 575
fungi grown from conjunctiva, cornea and lacrimal passages, 329
mixed tumor of, 759
nonpigmented nevus of lacrimal caruncle, 569
surgery; 1,200 plastic dacrocystorhinostomies, 1139
treatment of epiphora with strong solution of silver nitrate, 746
Lafon, R.: Some results of subungual capillaroscopy in ophthalmologic practice, 362
Lamb, H. D.: Cyclopia in new-born kitten; anatomic findings, *998

Lauber, J.: Low systemic blood pressure and its relation to intra-ocular tension and to diseases of optic nerve, 360
Laurence-Biedl syndrome, two brothers with Laurence-Moon-Biedl syndrome, 961
Law, F.: Congenital retinal anomaly, 349
Lebensohn, J. E.: Biochemistry of lens; mineral metabolism in normal and in cataractous lens, *217
Leber's Disease: See Nerves, optic
Lens, Crystalline: See also Zonule of Zinn
arachnodactylia and dislocated lens, 1165
association of ectopia lentis with arachnodactyly, *645
biochemical changes in eye brought about by naphthalene and influence of vitamin C on them, 1141
biochemistry; cevitamic acid content of blood and urine of subjects with senile cataract, *78
biochemistry; mineral metabolism in normal and in cataractous lens, *217
changes typical of myotonic dystrophy, report of case, 1156
dehydrogenative processes after infra-red irradiation, 559
ectopia of, 136
experience in phako-erisis, 136
involution of tunica vasculosa lentis in monkeys, 323
microphakia and spherophakia with glaucoma, 134
new ways of studying accommodation; elasticity of zonula, 562
Opacity: See Cataract
phospholipid content of cataractous human lenses, 1140
physicochemical studies on normal and pathologic lens, 1131
posterior lenticonus, report of case, 131
posttraumatic myopia and aphakia, 334
problem of, *859
rôle of vitamin C in oxidation process of lens, 127
Lenticonus: See Lens, Crystalline
Lenticular Nucleus, Wilson's disease (progressive lenticular degeneration) with Kayser-Fleischer ring, 1165
Letters of Albrecht von Graefe to F. C. Donders (1852 to 1870), 1138
Leukoscope, detection of color blindness with leukoscope of Hering, 128
Levinsohn, G.: Reply to criticisms of my theory on genesis of myopia, *84
Light: See also Ultraviolet Rays
artificial daylight for testing color sense with Ishihara's charts, 331
binocular integration of hue and brilliance, *443
Reflex: See Reflex, pupillary
sense in arteriosclerosis and malaria, 744
spontaneous dialysis of iris caused by sudden strong flash of light, 2 cases, 949
Lighting, visual acuity for white objects seen against black background, 341
Limbus Cornea: See under Cornea
Lindner Operation: See Retina, detachment
Lipemia: See Blood, fats and lipoids
Lipids: See Blood, fats and lipoids; Lipoids
Lipodystrophia progressiva with ocular complications, 773
Lipoid-Histiocytosis: See Niemann's Disease
Lipoids, phospholipid content of cataractous human lenses, 1140
Livingstone, P. C.: Binocular vision in everyday life with description of binocular gage, 152
Cystic swelling of retina, 150
Lloyd, R. I.: Evolution of perimetry, *713
Hereditary macular degenerations, 774
López-Enríquez: Demonstration of apparatus for examination of eye, 353
New method of determining when rays from magnifying lens are parallel, convergent or divergent, 364
Recent cytologic studies of pathologic vitreous, 354
Loupe: See Apparatus
Lucic, H.: Neoarsphenamine in treatment of nonsyphilitic inflammations of uveal tract, *826
Ludvigh, E. J.: Is ocular proprioceptive sense concerned in vision? *1037
Lupus erythematosus, choroiditis in cases of, 571
Lux, P.: Cicatricial ectropion as result of mucocele of frontal sinus; plastic repair, *994
Lyle, T. K.: Corneal dystrophy with relapsing attacks of keratitis, 576
Lymphangiectasis: See Lymphatic System
Lymphatic System, hemorrhagic lymphangiectasis of conjunctiva, 925
Lysins: See Bacteriophage
Lysozyme, concentration in tears in acute and chronic conjunctivitis, 960

McAdams, W. R.: Intracapsular extraction of cataract in average practice; report of 100 cases in which Verhoeff's method was used, *95
McArdle: Wilson's disease (progressive lenticular degeneration) with Kayser-Fleischer ring, 1165
MacDonald, A. E.: Kinetic stereoscopy or stereoscopic phenomena of moving observer, 952
McKee, S. H.: Metastatic ophthalmia in patient with pneumonia; bacteriologic observations, 787
McLeod, J.: Cicatricial ectropion as result of mucocele of frontal sinus; plastic repair, *994
Macula Lutea, bilateral familial microphthalmos associated with congenital macular degeneration, 1144
hereditary macular degenerations, 774
lesions combined with hair anomaly in 2 brothers, 146
lesions of capillary origin, 336
sarcoma, 348
twinning and ocular pathology with report of bilateral macular coloboma in monozygotic twins, *1050
Malaria, light sense in arteriosclerosis and malaria, 744
rôle in control of atrophy of optic nerve due to syphilis, study of 12 cases, *250
therapy and optic atrophy, 572
Malingering, device for detection of malingerers, *520
Malnutrition: See Nutrition
Mann, I.: Congenital retinal anomaly, 349
Mann, W. A., Jr.: Cataract due to di-nitrophenol, *116
Marble, A.: Blood lipids in lipaemia retinalis, *86
Marfan's Syndrome: See Fingers and Toes, abnormalities
Marriage, congenital bilateral melanosis occurring in eye and face; contribution to problem of consanguinity, 324
Marshall, C.: Bipolar electrolytic treatment of detachment of retina, 151
Marshall, D.: Changes in refraction following operation for strabismus, *1020
Martin, P.: Progressive external ophthalmoplegia in case of myopathy, 574
Mastier, P.: Ocular complications and symptoms of "fièvre exanthématique," 353
Medal, Leslie Dana Gold Medal to Dr. John M. Wheeler, 1121
Meek, R. E.: Successful use of nonpenetrating diathermy in 2 cases of detachment of retina, 1156
Melanoma, ciliary margin of dilator muscle of pupil with reference to some melanomas of iris of epithelial origin, *985
Melanosis, benign ocular, 751
congenital bilateral, occurring in eye and face; contribution to problem of consanguinity, 324
Mengel, W. G.: Rapidly developing cataracts following use of di-nitrophenol, 346
Mengert, W. F.: Virus of inclusion conjunctivitis; further observations, *377; correction, 734
Meninges, meningoblastoma of optic nerve, 947
syndrome of meningeal fibroblastoma arising from lesser wing of sphenoid bone, *163
Meningioma of optic nerve within orbit, 1162
Meningitis, cerebrospinal, ocular complications of, *118
Meningoblastoma of optic nerve, 947

Meningo-encephalitis, chronic tuberculous juvenile, with pubertas praecox, choked disk and bitemporal hemianopia, 1143
Meyer, G.: Mechanism of fovea, 782
Microphakia: See under Lens, Crystalline
Microphthalmos: See Abnormalities and Deformities
Mineral metabolism in normal and in cataractous lens, biochemistry of lens, *217
Monsters, cyclopia, *114
cyclopia in new-born kitten; anatomic findings, *998
embryological basis of cyclopia, 551
Moon-Laurence-Biedl Syndrome: See Laurence-Biedl syndrome
Morax Operation: See under Cornea
Mouth, pseudomembranous nondiphtheritic conjunctivitis accompanying eruptive and buccopharyngeal lesions, 129
Moutinho: Three cases of anophthalmia, clinical observation, 359
Mucocele, cicatricial ectropion as result of mucocele of frontal sinus; plastic repair, *994
Mucous membrane graft, symblepharon from pemphigus corrected with, 789
Mumps: See Parotitis
Muscles, ciliary margin of dilator muscle of pupil with reference to some melanomas of iris of epithelial origin, *985
hyperphoria associated with overaction of inferior oblique muscle: treatment by recession of origin of muscle, 150
investigation of musculature of lacrimal passages, 1129
nerve supply to orbicularis muscle and physiology of movements of upper eyelid with reference to pseudo-Graefe phenomenon, *21
Ocular: See Eyes, muscles; Strabismus
Mydriasis: See Pupils, dilatation
Myiasis, ophthalmomyiasis; review of literature and report of case of ophthalmomyiasis interna posterior, 1153
Myopia and exophoria, 549
genesis of, reply to criticisms of theory on, *84
posttraumatic, and aphakia, 334
Myotonia, Dystrophica: See Dystrophy, muscular

Nagel Test: See Color Blindness
Napthalene, biochemical changes in eye brought about by naphthalene and influence of vitamin C on them, 1141
Neame, H.: Angiomata retinae (Hippel's disease), 1164
Fuchs' epithelial dystrophy, 347
Macular sarcoma, 348
Needle-holder for ophthalmic and other delicate surgery, *111
Negri Bodies: See Rabies
Neoarsphenamine: See Arsphenamine
Nephritis, crownlike detachment of retina in patient with nephritis, 944
Nerves: See also under Neuritis; Paralysis; etc.
differentiation of ocular reflex arc in larval salamander, 554
hypertensive fundus oculi after resection of splanchnic sympathetic nerves; preliminary report, *840
nerve supply to orbicularis muscle and physiology of movements of upper eyelid with reference to pseudo-Graefe phenomenon, *21
optic, atrophy and malaria therapy, 572
optic, atrophy; periarterial sympathectomy (Leriche-Doppler) for treatment of atrophies of retina and optic nerve, 565
optic, atrophy, with rare form of intermittent exophthalmos, 940
optic; cerebral echinococcus cyst and ocular complications; report of 2 cases, 941
optic; endothelioma of optic nerve sheaths, 759
optic, functional study of nerve elements of optic pathway by means of recorded action currents, 562
optic; hyaline bodies on disks, 145
optic; intra-ocular tumor, 575
optic, low systemic blood pressure and its relation to intra-ocular tension and to diseases of optic nerve, 360
Nerves—Continued
optic, meningioma within orbit, 1162
optic, meningoblastoma of, 947
optic; obscure influence of general blood pressure on progress of optic nerve disease, 757
optic, primary tumor of, 568
optic, primary tumor with report of case, *696
optic, rôle of malaria in control of atrophy of optic nerve due to syphilis; study of 12 cases, *250
optic; sarcoma of optic papilla, 1152
optic; syndrome of meningeal fibroblastoma arising from lesser wing of sphenoid bone, *163
optic, tumor of, report of case, *686
optic; vitreous detachment, anterior dialysis and presence of tumor-like mass over optic nerve, 782
Nervous System: See also Brain; Nerves; Reflex; Spinal Cord; etc.
hemangioblastomatosis of retina and central nervous system with visceral lesions (von Hippel-Lindau disease), 957
pupil considered as revealer of functional correlation between somatic and vegetative systems, 141
Syphilis: See Syphilis
Neurinoma, orbital, 149
Neuritis, optic, and papilledema, *1
optic; cerebral echinococcus cyst and ocular complications; report of 2 cases, 941
optic; chronic tuberculous juvenile meningo-encephalitis with pubertas praecox, choked disk and bitemporal hemianopia, 1143
optic; differential diagnosis between choked disk and papillitis, 756
optic; histopathology of choked disk, 789
optic, in course of treatment by injections of pentavalent arsenicals, 335
optic, of sphenoid sinus origin as documented histologically, 359
optic; papilloretinal exudate of dental origin, 145
optic; studies in protein content of human aqueous, 739
optic; sympathetic neuroretinitis, 1154
optic; transitory choked disk; report of case with 11 year follow-up study, *36
subacute combined degeneration of spinal cord in pernicious anemia with retrobulbar neuritis, 575
Neurofibrillitis: See Retinochoroiditis
Neurofibromatosis, familial, 760
Neuroretinitis: See Neuritis, optic; Retinitis
Neurosyphilis: See Syphilis
Nevi, nonpigmented, of bulbar conjunctiva, 1152
nonpigmented, of lacrimal caruncle, 569
New-Born Infants, dacryocystitis of, 559
ocular pathology of, 1135
Niemann's Disease, histopathology of eyeground changes in Niemann-Pick lipoidosis, 1135
Night Blindness: See Hemeralopia
Nitrophenol, cataract due to di-nitrophenol, *116
cataract following use of di-nitrophenol, 330, 747
di-nitrophenol cataract, 746
di-nitrophenol poisoning with cataract, 345
late development of cataract following use of di-nitrophenol about year before, 747
rapidly developing cataracts following use of di-nitrophenol, 330, 346
Northfield, D. W.: Third nerve palsy; aneurysm of posterior communicating artery; ligation of internal carotid artery, 1164
Northwestern University Medical School, course in ophthalmology at, 1121
Nutrition, malnutrition in relation to ulceration of cornea in gonorrheal ophthalmia neonatorum, 740
Nyctalopia: See Hemeralopia
Nystagmus and congenital head-nodding, report of case, *1032
latent, case of, 139
response of cross-eyed patients to vestibular examination; normally incited nystagmus; hypo-excitability of vestibule; asymmetrically incited nystagmus, 332
spontaneous ocular nystagmus and nystagmus elicited by certain procedures involving globe, 361

Obituaries:

Deutschmann, Richard, 736
Frost, W. Adams, 737
Heckel, E. B., 546
Percival, A. S., 738
Radcliffe, McCluney, 923
Wilbrand, Hermann, 735
Wilmer, William Holland, 1122

O'Brien, C. S.: Panophthalmitis due to Clostridium Welchii, *1088
Occupational Diseases: See Industrial Diseases
Oguchi's Disease: See Hemeralopia
Old age, hereditary cataract of senile and presenile types, *222
Ophthalmia: See also Conjunctivitis; Eyes, diseases
metastatic, in patient with pneumonia; bacteriologic observations, 787
neonatorum, gonorrheal, malnutrition in relation to ulceration of cornea in, 740
neonatorum, venereal disease and corneal traumas and ulcerations, 743
panophthalmitis due to Clostridium Welchii, *1088
sympathetic, etiology and pathogenesis of idiopathic retinal detachment in, 572
sympathetic, inflammatory effect of phosphatide and its relation to, 763
sympathetic, notes on allergy theory of, 571
sympathetic, pathology and surgical treatment of, *59
sympathetic, simple experiment to prove tuberculotoxic origin of, 763
sympathetic, treatment by Speransky's method, 763
Ophthalmologic societies, directory of, 154, 368, 580, 794, 966, 1168
Ophthalmology, comparative; anatomy and physiology of pecten in bird's eye, 323
comparative; differentiation of ocular reflex arcs in larval salamander, 554
comparative; involution of tunica vasculosa lentis in monkeys, 323
comparative; minute structure of retina in monkeys and in apes, *477
comparative; reptilian retina; new concept of visual-cell evolution, 553
comparative; significance of reptilian "spectacle," 554
comparative; visual cells of lampreys, 130
Ophthalmoplegia: See Paralysis
Ophthalmoscopy: See Eyes, examination
Optic chiasm, shadows of calcareous deposits seen in roentgenograms of area of chiasm in cases complicated with glaucoma, 745
Optic Disk; Optic Papilla: See Nerves, optic; Neuritis, optic
Nerves: See Nerves, optic
Orbit, inflammatory exophthalmos in catarrhal disorders of accessory sinuses, *457
meningioma of optic nerve within orbit, 1162
neurinoma, 149
syndrome of floor of orbit, 361
tumor, exophthalmos from, 939
Orthoptic Training: See Strabismus
Oxidation: See Tissue, respiration
Oxygen, effect of lack of oxygen on dark adaptation, 1146

Paederus: See Beetles
Palin, A. G.: Siderosis bulbi; foreign body removed, 576
Pannus: See Trachoma
Panophthalmitis: See Ophthalmia
Papilledema: See Neuritis, optic
Paralysis, anatomic contribution to question of recurring paresis of oculomotor nerve; report of case, 750
general; blindness occurring in 2 patients with dementia paralytica under treatment with acetarsone (stovarsol) 343
progressive external ophthalmoplegia in case of myopathy, 574
third nerve palsy; aneurysm of posterior communicating artery; ligation of internal carotid artery, 1164
third nerve palsy following dental extraction, 1164
traumatic, of both nerves of sixth pair, 361
Parasites: See under Eyes
Parathyroid, relation between parathyroid glands and cataract in young people, 136
Paratrachoma: See Conjunctivitis
Park, G. E.: Precision angiometer, *703
Parotitis, epidemic, epibulbar subconjunctivitis in, 134
Pascal, J. I.: Myopia and exophoria, 549
Paton, L.: Papilledema and optic neuritis, *1
Two brothers with Laurence-Moon-Biedl syndrome, 961
Pecten Sclerae: See Sclera
Peet, M. M.: Hypertensive fundus oculi after resection of splanchnic sympathetic nerves; preliminary report, *840
Pemphigus, symblepharon from pemphigus corrected with mucous membrane graft, 789
Penman, G. G.: Excision of eye with implantation of fat graft in Tenon's capsule, 576
Perimetry: See under Vision
Periphlebitis, perivasculitis retinae (recurrent retinal hemorrhages in adolescence), 1148
Perivasculitis: See Periphlebitis
Pesme, P.: Presentation of pyrometric controller with variable zero for ocular diathermy, 356
Peter, L. C.: Diagnosis and differentiation of types of alternating concomitant squint, 766
Pfeiffer, R. L.: Roentgenographic diagnosis of retinoblastoma, *811
Phako-Erisis, my experience in, 136
Pharynx, pseudomembranous nondiphtheritic conjunctivitis accompanying eruptive and buccopharyngeal lesions, 129
Phlyctenulosis: See Conjunctiva, tuberculosis
Phorias, anatomic, *692
Phosphatides: See Phosphorus and Phosphorus Compounds
Phospholipids: See Lipoids
Phosphorus and Phosphorus Compounds, inflammatory effect of phosphatide and its relation to sympathetic ophthalmia, 763
Photography, infra-red, of eye; iris pigment, 137
infra-red, review with reference to its value in ophthalmology, *435
of eye with miniature camera, 1142
Pick-Niemann's Disease: See Niemann's Disease
Pituitary Body, Argyll Robertson syndrome occurring with pituitary tumors, 942
Pneumococci, metastatic ophthalmia in patient with pneumonia; bacteriological observation, 787
three cases of septicemia following pneumococcic conjunctivitis, 925
Pneumonia, metastatic ophthalmia in; bacteriologic observations, 787
Poikiloderma atrophicans vasculare, cataract in childhood with simultaneous occurrence of poikiloderma atrophicans vasculare; familial occurrence (Rothmund's disease) in Switzerland, 559
Polyak, S.: Minute structure of retina in monkeys and in apes, *477
Post, M. H.: Lipodystrophia progressiva with ocular complications, 773
New and practical charts and lighting for testing visual acuity and locating astigmatic axis, 772
Postgraduate course in ophthalmology and otolaryngology in summer, 545
work in ophthalmology and otolaryngology, 320
Pressure: See Tension
Protein content of human aqueous, 739
Pseudoxanthoma elasticum and angioid streaks, 756
Pterygium, bilateral temporal pterygia, 925
etiology and pathologic anatomy of, 925
Ptosis: See Eyelids, ptosis
Puberty: See Adolescence
Pulse, capillary pulsations of conjunctiva, 321
Pupils and central visual fields in patients with neurosyphilis, 771
Argyll Robertson sign persisting 3 years after herpes ophthalmicus, 754
Argyll Robertson syndrome occurring with pituitary tumors, 942
considered as revealer of functional correlation between somatic and vegetative systems, 141
Dilatation: See also under Reflex
dilatation; mydriatic for diagnostic purposes, 561
dilatation; effect of mydriatics on intraocular tension, 779

Pupils—Continued
isolated abolition of pupillary adaptation to light (semeiological value of Argyll Robertson sign), 753
pathologic retardation of absorption of pupillary membrane and its relation to other diseases, 132
physiology and pathology, course of normal light reflex, 754
pupillary reactions in combined lesions of posterior commissure and of pupillodilator tracts; contribution to pathogenesis of Argyll Robertson pupil, *195
unilateral reflex mydriasis in cats during labor and diseases of uterus, 141
Pyrotherapy: See under Fever

Quinine therapy for some diseases of conjunctiva and cornea, *31

Rabies, virus of vaccinia and of rabies developed in corneal epithelium, 556
Radium Therapy: See under names of various diseases
Rand, G.: Instrument for measuring dynamic speed of vision, speed of accommodation and ocular fatigue, *1072
Rankin, C. A.: Multilocular cyst of iris, 345
Raverdino, E.: Extraction of traumatic cataract with forceps, 363
Recklinghausen's Disease: See Neurofibromatosis
Reese, W. S.: Unusual case of blood-staining of cornea, 788
Reflex, additional component of convergence-accommodation reflex, 142
lid-closure reflex of pupil, 1142
physiology and pathology of pupil; course of normal light reflex, 754
pupillary; isolated abolition of pupillary adaptation to light (semeiological value of Argyll Robertson sign), 753
pupillary light reflex after lesions of posterior commissure in cat, 942
pupillary reaction in combined lesions of posterior commissure and of pupillodilator tracts; contribution to pathogenesis of Argyll Robertson pupil, *195
unilateral reflex mydriasis in cats during labor and diseases of uterus, 141
Refraction: See Accommodation and Refraction
Retina: See also Macula Lutea
abnormalities; congenital retinal fold, 926
angioid streaks, 756
angioid streaks of ocular fundus, 564
angioneurotic disturbances of, 755
anomaly, congenital, 349
ascorbic acid content of retina and adrenals of animals, 126
bilateral subhyaloid hemorrhages and retinal hemorrhages in patient with severe pernicious anemia, 1163
blood lipids in lipaemia retinalis, *86
Blood Supply: See also Aneurysm; Arteriosclerosis
blood supply; experimental studies of relation between pressure in retinal veins and intracranial pressure, 333
blood supply; hypotension of retinal artery, 335
blood supply; is hypertension instrumental in aiding development of diabetic retinitis? report of cases, 756
blood supply; ocular syndrome after concussion of brain; report of cases, 750
circulation of blood in case of retinitis exudative externa, 337
congenital retinal band in child, 577
cystic swelling of, 150
detachment, anatomicopathologic studies of effect of thermopuncture and of diathermy puncture in 2 cases of, 944
detachment and postoperative hemorrhage, 355
detachment, bipolar electrolytic treatment of, 151
detachment, circumscribed, at ora serrata in beginning sarcoma of choroid, 4 cases, 945
detachment, crownlike, in patient with nephritis, 944
detachment; diathermic and galvanic treatment of separated retina, especially of flat type, with specially devised minimal stop and single and multiple platinum microelectrodes; new magazine containers, 768
Retina—Continued
detachment, eclamptic, 963
detachment; etiology and pathogenesis of idiopathic detachment in sympathetic ophthalmia, 572
detachment, evolution of treatment of, 1147
detachment, experimental, 1134
detachment following simple extraction of cataract, 576
detachment, idiopathic, medical problem of, 355
detachment, improvements in technic of pyrometric diathermocoagulation in treatment of, 358
detachment, influence of excision of sclera after Lindner on anterior segment of eye, 336
detachment, localization of retinal hole, 1147
detachment, mechanics in cases of intraocular tumor, 338
detachment, microscopic observations in 2 eyes in which retinal detachment had been treated by diathermy, 1157
detachment, new electrode for surgical diathermy of, *711
detachment of retinal vessels, 2 cases of, 564
detachment, operative treatment of, 356
detachment, pathologic observations after ignipuncture (Gonin), 337
detachment, pathologic observations after ignipuncture (Gonin); remarks in answer to paper by E. F. Lewkojewa, 337
detachment; special device for localization and treatment of retinal tear with galvanic current, *1094
detachment, successful use of nonpenetrating diathermy in 2 cases of, 1156
detachment, surgical treatment by Šafář's technic, 565
detachment, treatment by means of diathermocoagulation, 356
detachment, vitreous detachment, anterior dialysis and presence of tumor-like mass over optic nerve, 782
diathermic diaphanoscope, 357
entoptic phenomena associated with retina, 142
hypertensive fundus oculi after resection of splanchnic sympathetic nerves; preliminary report, *840
Inflammation: See Retinitis; Retinochoroiditis
ischemia following uterine hemorrhages, 145
mechanism of fovea, 782
minute structure in monkeys and in apes, *477
ocular dominance, its independence of retinal events, *890
periarterial sympathectomy (Leriche-Doppler) for treatment of atrophies of retina and optic nerve, 565
physiology; electrical response of eye to light, 1144
reattachment of detached right retina after extensive operation to seal up 7 holes, 574
reptilian, new concept of visual-cell evolution, 553
retinal angioscopy and early diagnosis of cardiovascular disease, 354
secretory function of retinal pigmented epithelium in retinitis exudativa externa (Coats), 146
self-examination of fundus of eye, 1142
tears without detachment, 355
tumors; angiomata retinae (Hippel's disease), 1164
tumors; hemangioblastomatosis of retina and central nervous system with visceral lesions (von Hippel-Lindau disease), 957
vasomotor system in retinal and cerebral vascular lesions, 144
water-binding of, 551
Retinitis exudative externa, circulation of blood in retina in case of, 337
exudative; secretory function of retinal pigmented epithelium in retinitis exudativa externa (Coats), 146
is hypertension instrumental in aiding development of diabetic retinitis? report of cases, 756
papilloretinal exudate of dental origin, 145
physiopathology of, 353

Retinitis—Continued
pigmentosa, genealogies in 28 cases of hereditary pigmentary degeneration of retina, 945
serous, 783
sympathetic neuroretinitis, 1154
Retinoblastoma, familial, treatment with radon seeds, 1163
roentgenographic diagnosis of, *811
Retinochoroiditis, favorable influence of double carotid sympathectomy in case of atrophic chorioretinitis, 1154
Rice, C. O.: Lens changes typical of myotonic dystrophy; report of case, 1156
Rickets, application of microquinhydrone electrode to determination of p_H of aqueous humor of rachitic and normal rats, 1130
Rickettsia-like bodies in trachoma follicles, 758
bodies in trachomatous tissues, 146
Ridley, H.: Case of keratitis caused by mustard gas, 1165
Robertson, C. J.: Measurement of speed of adjustment of eye to near and far vision; further study, *423
Rothmund Syndrome: See Cataract
Royal London Ophthalmic Hospital, visit to King George V extension, *185
Rugg-Gunn, A.: Hyperphoria associated with overaction of inferior oblique muscle; treatment by recession of origin of muscle, 150
Rutherford, C. W.: Central visual fields and pupils in patients with neurosyphilis, 771

Šafář Operation: See Retina, detachment
Samuels, B.: Histopathology of choked disk, 789
Notes on pathology and surgical treatment of sympathetic ophthalmia, *59
Royal London Ophthalmic Hospital; visit to King George V extension, *185
Serous retinitis, 783
Samuelson, A.: Primary tuberculosis of conjunctiva, *975
Sarcoma, circumscribed detachment of retina at ora serrata in beginning sarcoma of choroid, 4 cases, 945
epibulbar, treated by excision, 959
macular, 348
of ciliary body, 1163
of optic papilla, 1152
Scala, N. P.: Pupillary reactions in combined lesions of posterior commissure and of pupillodilator tracts; contribution to pathogenesis of Argyll Robertson pupil, *195
Scarlett, H. W.: Effect of bacterial lysate on staphylococcic keratoconjunctivitis in rabbits, *47
Scars: See Cicatrix
Schlemm's Canal: See under Eyes
Schoen, Z. J.: Ocular dominance; its independence of retinal events, *890
Schwartz, L. H.: Device for detection of malingerers, *520
de Schweinitz, G. E.: William Holland Wilmer, 1127
Sclera, anatomy and physiology of pecten in bird's eye, 323
blue, syndrome of, 929
fistula at limbus (scleromalacia perforans), 325
pathologic lipoid infiltration of cornea and sclera, 134
Sclerosing injections, treatment of angioma of eyelid by, 764
Scotoma, angioscotomas and gold sodium thiosulfate, 941
symmetric incomplete annular scotoma of tobacco origin without enlargement of blind spot, 343
transient fluctuations in scotoma of glaucoma, 1137
Scrofula: See Tuberculosis
Selinger, E.: Local quinine therapy for some diseases of conjunctiva and cornea, *31
Sella turcica, syndrome of meningeal fibroblastoma arising from lesser wing of sphenoid bone, *163
Senility: See Old age
Septicemia following pneumococcic conjunctivitis, 3 cases, 925
Sex and ametropia, 943
Shapland, C.: Arachnodactylia and dislocated lens, 1165
Siderosis bulbi; foreign body removed, 576
Simpson, W. M.: Artificial fever therapy in cases of ocular syphilis, *624
Sinus, Frontal: See Frontal sinus
Sinuses, nasal; inflammatory exophthalmos in catarrhal disorders of accessory sinuses, *457
Skin, temperature changes in conjunctiva in relation to application of heat and cold to skin, 1132
Skull: See Cranium
Smallpox, vaccination; virus of vaccinia and of rabies developed in corneal epithelium, 556
venereal disease and corneal traumas and ulcerations, 743
Smith, H.: Aqueous; its generation, functions and circulation, *40
Smith, J. W.: Aniridia; report of 3 cases in 1 family, 956
Smith, R. M.: Blood lipids in lipaemia retinalis, *86
Societies, American Academy of Ophthalmology and Otolaryngology, meeting, 544, 921
American Board of Ophthalmology, examinations, 320
American College of Surgeons, meeting, 544
Association for Research in Ophthalmology, 1119
British Medical Association, Section on Ophthalmology, 921
correction in transcript of German Ophthalmological Society held Aug. 6 to 8, 1934 (13: 914 [May] 1935), 125
foreign, directory of, 154, 368, 580, 794, 966, 1168
French Ophthalmological Society, 734
German Ophthalmological Society, 733
International Association for Prevention of Blindness, 1120
international, directory of, 154, 368, 580, 794, 966, 1168
International Ophthalmological Congress, meeting, 125
local, directory of, 158, 372, 584, 798, 970, 1172
national, directory of, 155, 369, 581, 795, 967, 1169
National Society for Prevention of Blindness, 1119
ophthalmologic, directory of, 154, 368, 580, 794, 966, 1168
Ophthalmological Society of United Kingdom, annual meeting, 125, 320, 733, 1120
sectional, directory of, 155, 369, 581, 795, 967, 1169
Société d'Ophthalmologie de Paris, 734
state, directory of, 156, 370, 582, 796, 968, 1170
Society Transactions:
American Medical Association, Section on Ophthalmology, eighty-sixth annual session, 951
American Ophthalmological Society, 766; correction, 965
College of Physicians of Philadelphia, Section on Ophthalmology, 345, 788
French Ophthalmologic Society, 351
New York Academy of Medicine, Section of Ophthalmology, 956, 1156
Royal Society of Medicine, London, Section of Ophthalmology, 150, 347, 574, 961, 1160
Sorsby, A.: Allergic tests in connection with external ocular conditions, 1161
Phlyctenular keratitis, 1120
Soudakoff, P. S.: Advanced stage of diktyoma: report of case, *680
Spaeth, E. B.: Di-nitrophenol poisoning with cataract, 345
Symblepharon from pemphigus corrected with mucous membrane graft, 789
Spasmus Nutans: See under Head
Spectacles: See Glasses
Sphenoid bone, syndrome of meningeal fibroblastoma arising from lesser wing of sphenoid bone, *163
Sphenoid sinus, optic neuritis of sphenoid sinus origin as documented histologically, 359
Spherophakia: See under Lens, Crystalline
Spiegel, E. A.: Pupillary reactions in combined lesions of posterior commissure and of pupillodilator tracts; contribution to pathogenesis of Argyll Robertson pupil, *195
Spinal Cord, subacute combined degeneration in pernicious anemia with retrobulbar neuritis, 575

Squint: See Strabismus
Stallard, H. B.: Sarcoma of ciliary body, 1163
Treatment of familial retinoblastoma with radon seeds, 1163
Staphylococci, pyogenic, considerations of 130 strains isolated from chronic conjunctival lesions, 1130
effect of bacterial lysate on staphylococcic keratoconjunctivitis in rabbits, *47
Steatosis: See Degeneration, fatty
Stereoscope: See Vision, stereoscopic
Sterilization, genealogies in 28 cases of hereditary pigmentary degeneration of retina, 945
Stieren, E.: Edward Balthasar Heckel, 548
Stilling Test: See Color Blindness
Strabismus, changes in refraction following operation for, *1020
diagnosis and differentiation of types of alternating concomitant squint, 766
mounting for Worth-Black amblyoscope, *898
of unusual origin with medical cure, 138
precision anglometer, *703
recession operation for squint, remarks on, 331
response of cross-eyed patients to vestibular examination; normally incited nystagmus; hypo-excitability of vestibule; asymmetrically incited nystagmus, 332
Strampelli, M.: Diathermic diaphanoscope, 357
Strumia, M. M.: Effect of bacterial lysate on staphylococcic keratoconjunctivitis in rabbits, *47
Suture: See under Eyelids
Symblepharon: See under Eyelids
Syntropan, mydriatic for diagnostic purposes, 561
Syphilids, syphilitic conjunctivitis (rare cases of ocular syphilis; conjunctival syphilids), 553
Syphilis, central visual fields and pupils in patients with neurosyphilis, 771
congenital, diagnostic value of changes in eye in early childhood, 932
congenital; venereal disease and corneal traumas and ulcerations, 743
experimental interstitial keratitis, 328
ocular, artificial fever therapy in, *624
reactions in ophthalmology, 357
rôle of malaria in control of atrophy of optic nerve due to syphilis; study of 12 cases, *250
therapy-resistant, especially parenchymatous keratitis and its treatment with quinine, 1133

Tabes dorsalis, infantile, 138
Tay-Sach's Disease: See Idiocy, amaurotic
Tears, concentration of lysozyme in tears in acute and chronic conjunctivitis, 960
Teeth, ocular disorders associated with wisdom tooth, 328
papilloretinal exudate of dental origin, 145
third nerve palsy following dental extraction, 1164
Tenon's capsule, excision of eye with implantation of fat graft in, 576
Tension: See also Glaucoma
intra-ocular, effect of mydriatics on, 779
low systemic blood pressure and its relation to intra-ocular tension and to diseases of optic nerve, 360
review of subject of artificially produced hypotony, 742
Testicles, preparations; later investigations on influence of testicular extract on penetration of drugs into eye, 753
Thermopuncture: See Retina, detachment
Thompson, R.: Concentration of lysozyme in tears in acute and chronic conjunctivitis, 960
Thorpe, H. E.: New forceps for removal of lead shot from vitreous, *308
Thygeson, P.: Virus of inclusion conjunctivitis: further observations, *377; correction, 734
Thyroid, tumor, choroidal metastasis of, 148
Tillé, H.: Spontaneous ocular nystagmus and nystagmus elicited by certain procedures involving globe, 361
Tissue, respiration: dehydrogenative processes in lens after infra-red irradiation, 559
respiration; rôle of vitamin C in oxidation process of lens, 127
Tobacco, nyctalopia caused by tobacco amblyopia in chauffeurs, 764
Tobacco—Continued
symmetric incomplete annular scotoma of tobacco origin without enlargement of blind spot, 343
Tonosciliography: See Blood pressure, determination
Tooke, F. T.: Tuberculosis of choroid associated with generalized miliary tuberculosis, 781
Torticollis, myectomy of left inferior oblique muscle for ocular torticollis, 574, 575
Toti Operation: See under Lacrimal Organs
Trachoma and paratrachoma, 1151
chief preventable blinding diseases of childhood, 742
corneal pitting, 567
corneal pitting, precise origin of, 758
cytology and histology of, 568
effect of diet and vitamins on, 146
experimental pathology, 947
follicles in choroid and in vitreous of animals after intra-ocular inoculation with trachomatous material, 758
follicles, presence of inframicrobial elements in, 1149
follicles, rickettsia-like bodies in, 758
infectivity of, 566, 946
influence of dietary deficiency on transmissibility to monkeys, 566
inoculation of rabbits with material gained from trachoma; follicle-forming agents, 147
inoculation of trachomatous material into chickens, 1150
inoculation of virus of inclusion blennorrhea into trachomatous eyes, 340
local quinine therapy for some diseases of conjunctiva and cornea, *31
new treatment, results of, 148
recent advances, 338
recent advances and principles of prophylaxis, 567
resistant, mechanical treatment in, 1150
rickettsia-like bodies in trachomatous tissues, 146
studies on vascularization of cornea; histologic changes accompanying corneal sensitiveness, 327
surgical treatment, 567
Trainor, M. E.: Trainor operation for lid ptosis, 954
Trichlorethylene: See Chloro-Ethylene
Truc Operation: See Eyelids, surgery
Tuberculosis: See also under special structures of eye and names of diseases, as, Choroid, tuberculosis; Conjunctiva, tuberculosis; Iridocyclitis, tuberculous; Uvea, tuberculosis; etc.
chronic miliary, case of, 931
gold therapy; angioscotomas and gold sodium thiosulfate, 941
methylic antigen and tuberculosis of external segment, 329
miliary, generalized, associated with tuberculosis of choroid, 781
ocular, dormant, diagnosis by means of agglutination reaction of Holiande, 1129
ocular, fundamental treatment of, 133
simple experiment to prove tuberculotoxic origin of sympathetic ophthalmia, 763
tuberculous allergy and so-called phlyctenular keratoconjunctivitis, 555
Tumors: See also Angioma; Epithelioma; Fibroblastoma; Melanoma; Meningioma; Neurinoma; Sarcoma; etc., and under special structures of eyes
mixed, of lacrimal gland, 759
Tunica Vasculosa Lentis: See under Lens, Crystalline
Twins, twinning and ocular pathology with report of bilateral macular coloboma in monozygotic twins, *1050
Typhus, ocular complications and symptoms of "fièvre exanthématique," 353
Tyson, H. H.: Epibulbar sarcoma treated by excision, 959

Ulcers, Corneal: See Cornea, ulcers
Rodent: See Cornea, ulcers
Ultraviolet Rays, minimal quantity of ultraviolet and of infra-red rays which will cause damage to eye, 1134
Urine, biochemistry of lens; cevitamic acid content of blood and urine of subjects with senile cataract, *78

Uterus, hemorrhages, ischemia of retina following, 145
unilateral reflex mydriasis in cats during labor and diseases of uterus, 141
Uvea, advanced stage of diktyoma, report of case, *680
anomaly of ciliary body associated with congenital cataract, 926
cystlike ectropion uveae, 345
fatty degeneration and infiltration, 571
inflammation; neoarsphenamine in treatment of nonsyphilitic inflammations of uveal tract, *826
occurrence of ciliary processes on iris, 739
sarcoma of ciliary body, 1163
tuberculosis, conglomerate, of uveal tract, 570
Uveitis: See Uvea, inflammation
Uveoparotid Fever, aspects of Heerfordt's syndrome, 760
uveoparotid tuberculosis, report of 3 cases, 570
uveoparotitis, 569
uveoparotitis (Heerfordt), report of case, *1098
Uyama, Y.: White ring in cornea, *309

Vaccinia: See Smallpox, vaccination
Vail, D.: Epithelial downgrowth into anterior chamber following cataract extraction; arrest by radium treatment, *270
Vasomotor System, diseases; angioneurotic disturbances of retina, 755
in retinal and cerebral vascular lesions, 144
Velonoscopy: See Accommodation and Refraction
Verhoeff, F. H.: Kinetic test for stereoscopic vision, *833
New needle-holder for ophthalmic and other delicate surgery, *111
New theory of binocular vision, 1117
Verhoeff's Method: See under Cataract
Viallefont, H.: Some results of subungual capillaroscopy in ophthalmologic practice, 362
Viard, P.: Results of treating glaucomatous states with new calcium-magnesium compound, 360
Vinsonhaler, F.: Hereditary cataract of senile and presenile types, *222
Viruses, filtrable; studies on infectivity of trachoma, 946
Viscera, hemangioblastomatosis of retina and central nervous system with visceral lesions (von Hippel-Lindau disease), 957
Vision: See also Accommodation and Refraction; Blindness; Eyes, examination; etc.
binocular, in everyday life with description of binocular gage, 152
binocular integration of hue and brilliance, *443
binocular, new theory, 1117
central visual fields and pupils in patients with neurosyphilis, 771
Color: See Color Perception
disturbance of fusion after concussion of brain, report of cases, 749
evolution of perimetry, *713
functional study of nerve elements of optic pathway by means of recorded action currents, 562
influence of labyrinthine stimuli on visual field, 342
instrument for measuring dynamic speed of vision, speed of accommodation and ocular fatigue, *1072
investigation of visual field at low oxygen and atmospheric pressures, 761
is ocular proprioceptive sense concerned in vision? *1037
is there physiologic weakness of attention in nasal periphery of visual field? 761
kinetic stereoscopy or stereoscopic phenomena of moving observer, 952
measurement of speed of adjustment of eye to near and far vision; further study, 423
new and practical charts and lighting for testing visual acuity and locating astigmatic axis, 772
ocular dominance, its independence of retinal events, *890
ocular syndrome after concussion of brain, report of cases, 750
physiology; entoptic phenomena associated with retina, 142
reptilian retina; new concept of visual-cell evolution, 553
Vision—Continued
stereoscopic, kinetic test for, *833
subjective "lightning streaks," 755
syndrome of meningeal fibroblastoma arising from lesser wing of sphenoid bone, *163
torsion associated with near vision, 139
visual acuity for white objects seen against black background, 341
visual cells of lampreys, 130
Vitamins, avitaminosis and xerophthalmic syndrome, 930
C; ascorbic acid content of retina and adrenals of animals, 126
C; biochemical changes in eye brought about by naphthalene and influence of vitamin C on them, 1141
C, biochemistry of lens; cevitamic acid content of blood and urine of subjects with senile cataract, *78
C, rôle in oxidation process of lens, 127
effect of diet and vitamins on trachoma, 146
in ophthalmology, 1135, 1160
trophic ulcer of cornea cured by local vitamin therapy, 929
Vitreous Humor, action of *p*H of medium on state of swelling of vitreous body, 1153
bilateral subhyaloid hemorrhages and retinal hemorrhages in patient with severe pernicious anemia, 1163
chlorine content of aqueous, vitreous and serum, 126
clinical studies on etiology of recurring juvenile hemorrhages in vitreous, report of cases, 1149
colloidal properties and tonus, 761
detachment, acute spontaneous posterior, 10 cases of, 342
detachment, anterior dialysis and presence of tumor-like mass over optic nerve, 782
new forceps for removal of lead shot from vitreous, *308
new ways in study of accommodation; vitreous in accommodating eye, 334
perivasculitis retinae (recurrent retinal hemorrhages in adolescence), 1148
recent cytologic studies of pathologic vitreous, 354
ring-shaped detachment of vitreous body behind lens, 949
slit-lamp examination of alterations of anterior segment of eye and of vitreous in diabetic patients, 341
trachoma follicles in choroid and in vitreous of animals after intra-ocular inoculation with trachomatous material, 758
vitreous body and glaucoma, 558

Walker, C. B.: Diathermic and galvanic treatment of separated retina, especially of flat type, with specially devised minimal stop and single and multiple platinum microelectrodes; new magazine containers, 768
Special device for localization and treatment of retinal tear with galvanic current, *1094
Wallace, S. R., Jr.: Ocular dominance; its independence of retinal events, *890
Washburn, M. F.: New theory of binocular vision, 1117
Water binding of retina, 551
Weekers, L.: Operative treatment of detachment of retina, 356
Wexler, D.: Microscopic observations in 2 eyes in which retinal detachment had been treated by diathermy, 1157
Whiting, M.: Arachnodactylia and dislocated lens, 1165
Wilson's Disease: See Lenticular Nucleus
Woods, A. C.: William Holland Wilmer, 1125
Worms, G.: Optic neuritis of sphenoid sinus origin as documented histologically, 359
Wright, R. E:: Degeneration of cornea, calcareous (?) and fatty, *803
Wry-Neck: See Torticollis

Xanthelasma: See Xanthoma
Xanthoma, removal of xanthelasma with chronic acid, 959
Xerophthalmia, avitaminosis and xerophthalmic syndrome, 930
Xerosis: See Xerophthalmia

Ziporkes, J.: "White ring" in cornea, *112
Zona: See Herpes zoster
Zonule of Zinn, new ways of studying accommodation; elasticity of zonula, 562